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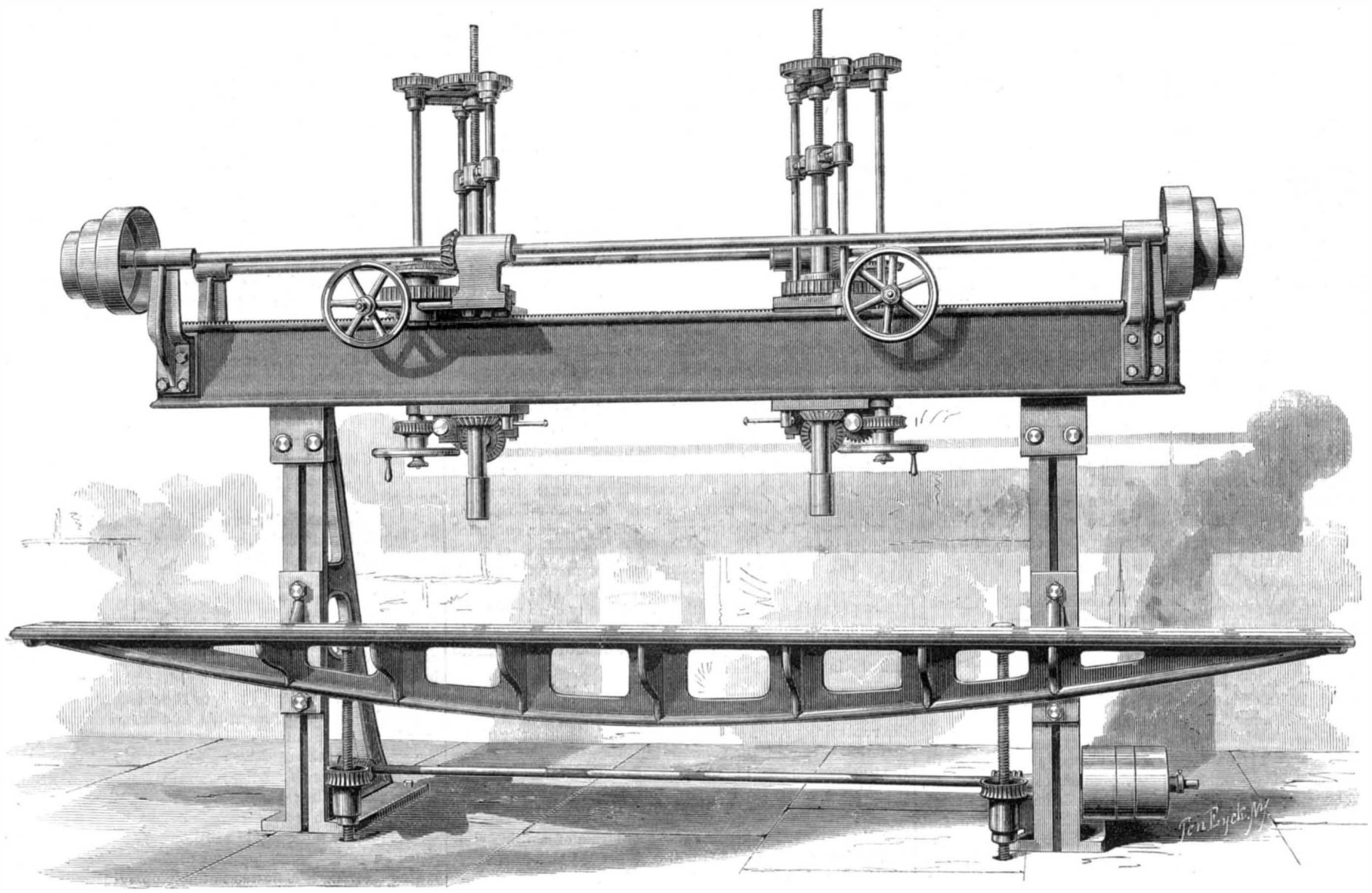
NEW DOUBLE SPINDLE DRILL.

We present herewith an engraving of a spindle drill which has been recently introduced into the market, and which, we learn, is coming largely into use for locomotive and railroad shops. The chief point of advantage to be noted is that both drills, having an automatic feed, can be attended by a single workman. The drills are also entirely independent of each other, and both can be moved to either end or any point in the frame. The table is so arranged as to rise



NEW DOUBLE SPINDLE DRILL.

and fall to suit the work to be operated upon. The tool is claimed to have all the advantages of two complete drill presses. The side frames of a locomotive may be placed upon the table against an angle plate, and all the holes, for nine feet, drilled without moving the work; this, we understand, has been accomplished. The table is made long enough to move the locomotive frame on end to drill the balance of the holes.

The machine has also been found to save a great amount of labor in drilling the bottom rings around the locomotive boiler furnace, where many holes have to be placed. It is stated, by a party using two of these drills, that one man is running all four of the spindles on water bottoms.

To Mr. W. S. Hudson, superintendent of the Rogers Locomotive and Machine Works, is due the credit of having suggested the idea and produced the plans which were the original of this machine. For further information address Hilles & Jones, makers of machinists' tools, Wilmington, Del.

An Invention Wanted.

A correspondent, L. L. B., says: "Plowshares, as now used, are enough to make any farmer complain, especially if they are steel ones, which are generally ruined after being sharpened once. The cast steel ones will not scour in black lands. Why could not the share be made smaller, so that it would not be necessary to weld a plate of iron on it? The share and point might be made of two pieces, and the point used in some way to fasten the share. Plugs or wedges could be used instead of bolts, which are so placed that they are hard to unscrew. Would not such a contrivance be as successful as the movable saw teeth? I think so. If such a thing could be made, it would be one of the most paying inventions."

Patent Bath Tub for Birds.

The shyness of birds in performing their ablutions is well known; but until A. D. 1873, no inventor has applied his powers in behalf of the feathered tribe, and they have been obliged to wash themselves in public. Cage birds have especially suffered in this respect, but, if their owners are sensible, they will suffer no longer. Mr. G. T. Peters, of Jersey City, N. J., has lately patented a bath tub for birds, in which a hood covers the water dish. The entrance is at one end only, and birdy creeps therein, as into a diminutive bath room, to enjoy a swim, without spattering the cage, in water not soiled by matter falling from the perches.

IMPROVED COOKING VESSEL.

This is an ingenious device, which may be easily arranged

in connection with any ordinary pot, serving to retain the lid while draining the water from the contents. It consists in attaching to the cover two lugs or care, A, by which the bail is supported in convenient position for grasping, and which, when the vessel is being emptied of its liquid, are pressed upon by the bail, thus holding the lid in place. On the side of the pot is made a projection, to which a handle is applied and the utensils thus readily tilted. Patented Sept. 17, 1872, by Mr. W. W. Tice, of California, Ohio.

The Origin of Mountains.

Professor James D. Dana contributes to the *American Journal of Science and Arts* a very learned treatise on some results of the earth's contraction from cooling, including a discussion of the origin of mountains and the nature of the earth's interior. In speaking of the kinds and structure of mountains, he draws a hitherto neglected distinction between: 1. A simple or individual mountain range or mass which is the result of one process of making, like an individual in any process of evolution, and which may be distinguished as a monogenetic range being one in genesis: and 2. A composite or polygenetic range or chain made up of two or more monogenetic ranges combined. The Appalachian chain—the mountain region along the Atlantic border of North America—is a polygenetic chain and consists of several other ranges, principal among which are the Green Mountains, the Alleghanies and the Highland, including the Blue Ridge and Adirondacks. Of these the first was completed essentially after the lower silurian era, the second immediately after the carboniferous era, and the third are pre-silurian in formation.

Mountain making is shown to be very slow work. After the begining of the primordial, the first period of disturbance of North America of special note was that at the close of the lower silurian, when the Green Mountains were finished. This interval between the beginning of the primordial and the metamorphism of the above range was at least 10,000,000 years. The next epoch of great disturbance in the same Appalachian region was that at the close of the carboniferous era, in which the Alleghanies were folded up; and altogether it is stated that the Appalachians were at least 35,000,000 years in making. The displacements of the Connecticut river sandstone and the accompanying igneous ejections, which occurred before the cretaceous era, took place for some 7,000,000 years after the Appalachian revolution. Thus it is demonstrated that the lateral pressure resulting from the earth's contraction required an ex-

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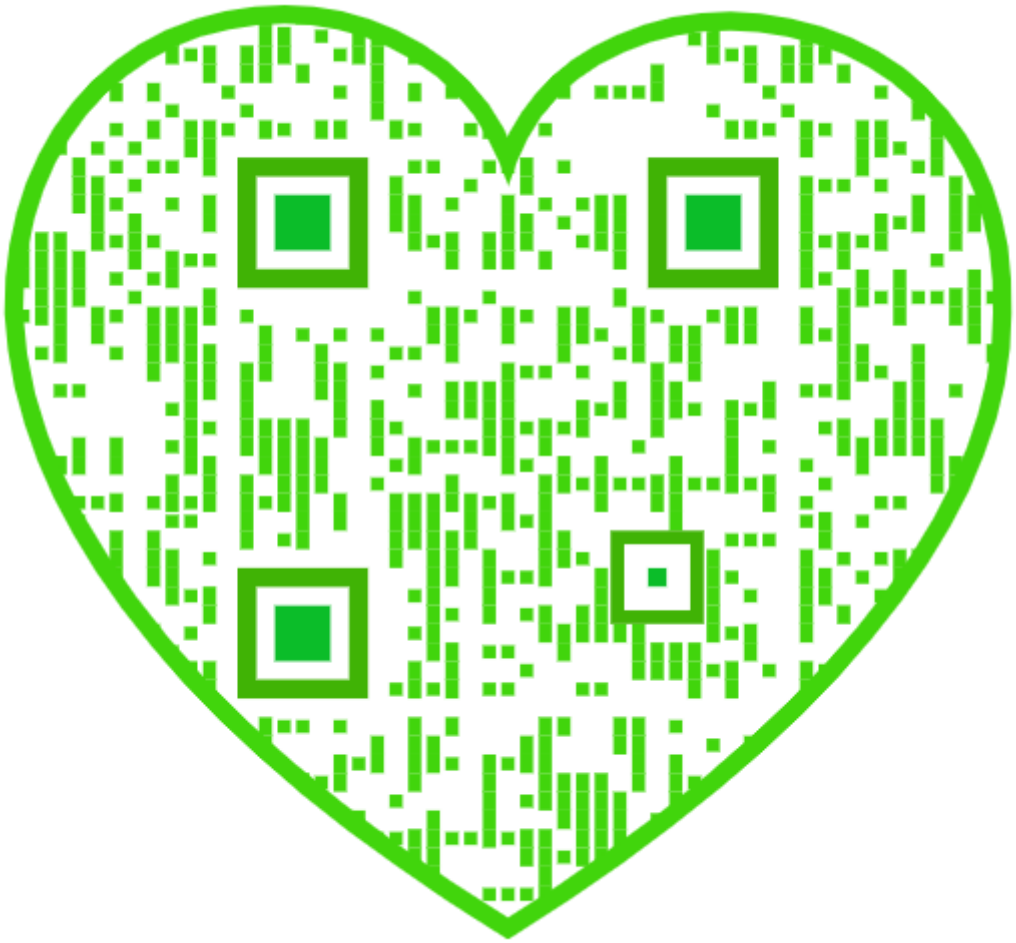

ceedingly long era in order to accumulate force sufficient to produce a general yielding and plication or displacement of the beds, and to start off a new range of prominent elevations over the earth's crust.

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Contents.

(Illustrated articles are marked with an asterisk.)

A B C process, the..... 392
American Institute fair, the..... 385
Anæsthetics..... 392
Answers to correspondents..... 395
Bath tub for birds..... 383
Belts, a new preventive for slipping..... 389
Belts, the power transmitted by... 389
Boiler explosion at Syracuse..... 389
Business and personal..... 395
Canal in Scotland, ship..... 393
Carmine, manufacture of..... 390
Chicago industrial exposition, the 385
Chlorates for calico printing..... 388
Cooking vessel, improved*..... 393
Decision, a common sense..... 386
Digestive apparatus, the..... 384
Diseases, prevention of artisans'.. 388
Diving bells..... 389
Electricity on metals, the effect of 388
Elevator, car and passenger*..... 391
Envelope, lock*..... 390
Fire escape, a new..... 385
Gelatin, preparation of..... 384
Hailstorm at St. Louis, Mo., a..... 389
Horse power..... 389
Iguana or tree lizard..... 391
Invention wanted, an..... 383
Magnetic needle, the diurnal variation of the..... 388
Mountains, the origin of..... 383
New York city North River traffic, the..... 385
Nickel plated speculum..... 391
Notes and queries..... 395
Patents, official list of..... 396
Patents, recent American and foreign..... 394
Perfumery and the sense of smell. 390
Planet between Mercury and the sun, the..... 391
Plow, improved*..... 387
Pneumatic foundations..... 384
Salt deposits of Canada..... 391
Sanitary notes..... 392
Scientific and practical information..... 395
Ship construction, iron*..... 387
Silkworms*..... 386
Spectroscope simplified, the..... 384
Spindle drill, double*..... 388
Spindle step, improved*..... 390
Sun's heat, the concentration of the..... 389
Tanite grinder and table*..... 390
Telegraph in Austria, the..... 388
Thick cylinders..... 384

THE DIGESTIVE APPARATUS.

It has rightly been said that the greatest object of study for man is man himself; this is true in a physical as well as in a moral sense. The human body, indeed, is almost a universe in itself, including many kinds of physical apparatus, statical, dynamical, hydraulic, chemical, optical, electrical, etc. The system of bones and muscles gives an example of the most perfect statical and dynamical arrangement; the heart, arteries, etc., of an admirable system of hydraulic contrivances; the digestive apparatus is a most complete chemical laboratory in itself, by which the material called food is metamorphosed into the living tissue of which man consists. We have, on a former occasion, glanced over the most striking features of man's hydraulic system, of which the heart is the main organ; let us now take a glance at the chemical laboratory which we carry with us, of which the stomach is the main organ, and which, as well as the circulation of the blood, is carried on incessantly, independently of our will and, when perfect, even without our knowledge.

The stomach is only one of the organs necessary for digestion. This operation, indeed, commences in the mouth, and extends nearly throughout the whole length of the so-called alimentary canal, which is about twenty-five feet long, and presents a surface, to be acted upon by the food, of some 4,000 square inches. In the mouth the food undergoes two operations, one mechanical and another chemical. The movements of the teeth, aided by the tongue, grind it up into small particles of proper size, while the simultaneous intermixture of the liquids secreted from three pair of salivary glands constitute the first chemical operation. Coated with a glary juice, the food passes along the œsophagus into the stomach (which is only an expansion between the œsophagus and the duodenum); this consists of three coats, one mucous, one muscular, and one serous, which is exterior. The interior or mucous coat has a velvety appearance, and is folded in wrinkles, so as to admit of much extension. When thus extended, certain appendages are stimulated and secrete three more liquids required for digestion. They are the gastric, pancreatic, and biliary juices.

The chemistry of these different agents, in the process of digestion has, during our time, been most minutely investigated. The saliva consists of a mixture of liquids, which differ for each of the three pairs of glands from which they originate; to these a fourth liquid is added, the buccal, proceeding from the lining membrane of the whole mouth; this mixture has the capacity of changing starch into grape sugar and, further, into lactic acid, which is essential to normal digestion. At the same time, the atmospheric oxygen is entangled in the saliva during mastication, and exerts an important influence in promoting the action of the saliva and gastric juice in the stomach.

The practical lesson which we draw from these well established facts are most important in a hygienic point of view. It deeply impresses us with the importance of well chewing our food, and with the injury which we do ourselves by eating hastily, by washing down imperfectly masticated food with water, tea, coffee, or something worse, and (which is the most injurious of all) by indulging in the bad habit of spitting, and thus intentionally wasting one of the main substances required for a healthy digestion. The result of the latter habit is a reduced quantity of urine secreted by the kidneys, and a consequent increase of the saline ingredients in the saliva, the salivary glands being thus induced to take up part of the functions of the kidneys; and, as Dr. John W. Draper very forcibly remarks, the dirty habit of profuse spitting results in "a partial conversion of the mouth into an urinary aqueduct."

Another important fact has been discovered by physiologists, namely, that the saliva of an infant, before it has its teeth, is incapable of converting starch into sugar. This explains at once why all attempts of substituting farinaceous food in place of mother's milk, in the case of infants, invariably fail; such children cannot digest starch, and are underfed, or even starved, dying finally of marasmus. Starch, arrowroot, sago, tapioca, etc., are useless, because indigestible, for children before they have cut their teeth.

The gastric juice, which is the principal ingredient for digestion, consists chiefly of the solution of a substance which has been called pepsin, and is remarkable from the fact that it contains nearly two per cent of nitrogen, a larger amount than any other substance in the body. The gastric juice behaves, chemically, like a very strong acid, dissolving zinc and iron under evolution of hydrogen; and its digestive power is impeded by the presence of any alkaline salt, while it is increased by the presence of fat.

The interior mucous membrane of the stomach, in which this gastric juice performs its functions, is reticulated; and at the bottom of each compartment are the mouths of the so-called follicles which, when seen under the microscope, resembles the fingers of a glove; and every stomach contains perhaps a million of them, each performing its absorbent function, as the polype extracts the nutritious parts of the food which he envelopes with the bag of which he consists, rejecting afterward the undigested portion. A human stomach may thus be considered as a colony of polypæ, which do not labor for their own sole benefit, but (under the control of the vitality of the individual) for the good of all, and of the body which they are destined to maintain.

THICK CYLINDERS.

A cylinder exposed to internal strain, if composed of elastic material, is stretched before rupture. The inner portion of the cylinder is stretched more than the outer; and the amounts of extension of the inner and outer portions will vary as their lengths. For instance: if the outer circumference of a cylinder is three times as great as the inner circumference, and, by the application of pressure, the inner circumference is stretched one thirtieth of its length, the outer circumference will be stretched one ninetieth of its length. It is easy to see, then, that all parts of a cylinder do not bear equal portions of the strain, and that the interior may be stretched to the point of rupture without an excessive strain being put upon the outer portion. It is found that the resistances of the different portions of a cylinder, subjected to internal pressure, vary inversely as the squares of their distances from the center; and an application of this principle will give the following rule for determining the rupturing strain per square inch: Multiply the tenacity of the material in pounds per square inch by the thickness of the cylinder in inches, and divide the product by the sum of the thickness and the internal radius in inches.

This rule may be thus expresssed: $P = \frac{T \times t}{r + t}$, where P is the rupturing pressure per square inch, T, the tenacity of the material, t, the thickness, and r, the internal radius. Where the thickness is small in comparison with the internal diameter, $\frac{T \times t}{r + t}$ is nearly equal to $\frac{T \times t}{r}$, which is the formula usually employed to find the bursting strain of a thin cylinder, such as a boiler. This will give a good idea of the distinction between thin and thick cylinders.

In our columns of "Answers to Correspondents" in this issue will be found a question relating to thick cylinders. The dimensions given are: T = 16,000, t = 5, r = 4; and by an application of the rule, we find the rupturing pressure per square inch to be $\frac{16{,}000 \times 5}{4 + 5} = 8{,}888{\cdot}9$ lbs. By increasing the thickness of this cylinder, the strength is increased very slowly in comparison; and it is a very common practice, in constructing thick cylinders, to place bands on the outside, to compensate for the small resistance to rupture offered by this portion.

PNEUMATIC FOUNDATIONS.

Colonel James B. Eads, well known to our readers as the engineer of the St. Louis bridge and other important structures, addresses a letter to *Engineering*, in which he takes issue with Colonel Roebling regarding some statements relative to the pneumatic foundations of the East River bridge, made by the latter gentleman in a pamphlet recently published. The disputed point relates to the position of the air lock within the shaft in the caisson, it being placed at the bottom and within the air chamber, making ingress and egress much more convenient than by any previous method, rendering it unnecessary to make the shaft airtight, and, besides, having many other advantages which need not here be enumerated. The idea of this improvement is, by Colonel Roebling, ascribed to Lord Cochrane, whom he states proposed it in 1831, and also to Wm. Bush and G. Pfanmuller, who subsequently brought it forward at intervals of some ten years; but he adds: "It remained for Captain Eads, in his St. Louis caissons, to make the first practical application of the same on a really large scale in this country."

Colonel Eads, in contradicting the above, asserts that Colonel Roebling appropriates his plans without acknowledgment, and then leads the public to suppose that they are the same as introduced by Pfanmuller nineteen years ago. He claims the origination of the idea, and not its mere application, and hence considers that Colonel Roebling does him an injustice in not giving him the credit to which he is justly entitled.

THE PREPARATION OF GELATIN.

In the ordinary manner of making light-colored gelatin, thin skins, sinews, cartilages, and bones are employed, which must be treated with muriatic acid and lime before being dissolved. These have furnished a good article, but at a high price. The expense of this process therefore induced F. Henze of Berlin to thoroughly investigate the subject of its manufacture in the hope of producing an equally good article at a lower price. The material employed was the brown, or almost black, glue of very poor quality, which is a by-product in a Berlin neatsfoot oil manufactory, and which sells for $5 per hundredweight. This substance does not swell up in cold water like glue, but forms a gummy mass, dissolving as a thick, sirupy liquid, not very adhesive but resembling that of which printers' rollers are made. It is now used only in making cardboard and as a dressing for very dark-colored fabrics.

In preparing this glue, the feet are first freed from hoofs and the more solid bones of the leg, which are used for turning into buttons and ornaments, and washed. They are then exposed for three hours to the action of superheated steam under a pressure of 2 atmospheres in a closed vessel; and after standing quietly half an hour, the liquid is drawn off. After skimming off the supernatant grease, the strong ammoniacal glue solution is strained and evaporated on a steam bath, and then furnishes the before mentioned blackish glue. When perfectly dry, it is very brittle and easily rubbed off between the fingers. Attempts to bleach it have yielded unfavorable results. It shows that it is already decomposed and is no longer gluten, or contains only very little of it. A large quantity of sulphurous acid partially bleaches it, but to employ this on a large scale would involve many technical difficulties. The fragile apparatus for making sulphurous acid would soon be broken in the hands of the workmen. Sulphite of soda could be dissolved in a very dilute glue solution, and then muriatic acid added to decompose this salt, if the quantity of the sulphite of soda required were not too large; but 50 kilogrammes of glue would require at least 2,500 grammes sulphite of soda and 2,250 grammes muriatic acid. The salts formed, which are sulphate of soda and chloride of sodium, as also the free acid, would in no case increase the quantity of glue, but on the contrary would render it utterly useless for many purposes in the arts. The process of bleaching with mineral acids would also destroy the iron evaporating pans, so that this method must be given up entirely.

All attempts at giving to the glue, when finished, the color desired having failed, no other course remained but to ascertain the cause of its becoming so dark-colored. The presence of sulphur and of considerable quantities of ammoniacal salts in the glue solution was too striking to escape notice very long. They could only have been caused by allowing the steam to act too long and too violently, whereby not only were the cartilages and gristle converted into glue, but the hair too had been dissolved, and thus caused the dark color. In order to reduce the decomposition of the glue and formation of ammonia to a minimum, the process may be varied in such a manner that, instead of drawing off the contents of the digester once at the end of three hours, they shall be drawn off hourly. On standing a little, the grease rises to the top and can be skimmed off, and then a quantity of fresh wood charcoal mixed with 25 per cent bone black is put into the liquid and left over night for the purpose of absorbing ammonia and other impurities. The following morning it is heated to the temperature at which gelatin melts, about 70° to 85° Fahr., strained and evaporated to the desired consistency. The amount of charcoal necessary is about 4 per cent of the quantity of glue in solution. The odor given off by evaporation after it has been purified with charcoal is quite pleasant and resembles that of *bouillon* soup, while that given off by the former method is one of the most disagreeable smells that ever polluted the atmosphere.

Glue prepared in this way answers all the requirements of a first class article. Even in thick layers the color is a pale wine yellow, and it possesses a high degree of elasticity. It has neither smell nor taste; and being always prepared from fresh material, it can be employed for all the purposes of so-called gelatin.

THE SPECTROSCOPE SIMPLIFIED.

Professor C. A. Young of Dartmouth College has recently made some interesting experiments in substituting fine ruled metallic plate in place of the prisms in a solar spectroscope designed for the observation of the solar prominences through the C line. The grating was ruled on spectrum metal by Mr. Rutherfurd of this city, the lines being $\frac{1}{6480}$ of an inch apart and the ruled surface covering something over a square inch. Professor Young says: "Combining this with the collimator and telescope of a common chemical spectroscope, we get an instrument furnishing a spectrum of the first order, in which the D lines are about twice as widely separated as by the flint glass prism of 60° belonging to the original instrument. In the neighborhood of C, the dispersion is nearly the same as would be given by four prisms." The outline of the chromosphere and the forms of the prominences were as well seen, both in spectra of the first and third order, as with the ordinary instrument. The spectra are somewhat fainter but their appearance is not injured.

President Morton, of the Stevens Institute, informs us that

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he has also tested a similar ruled plate with like satisfactory results. He suggests that, the ruled plates may be duplicated by electrotyping, and thus readily furnished by opticians at a price far below the expense of a train of prisms. If so,the production of spectroscopes at a very low price may be expected, and all who desire may possess them.

THE CHICAGO INTER-STATE INDUSTRIAL EXPOSITION.

New York is to have the yearly American Institute Fair, and, sometime in the future, a perpetual Industrial Exposition ; Philadelphia is absorbed in the prospect of the grandeur of the coming Centennial; Boston, probably, would announce a gigantic show, had not her triple infliction, in the shape of the Gilmore Jubilee and the two big fires, exhausted her energies; Cincinnati is to repeat the great Fair of last year; Louisville, doubtless, also; and even little Newark, not to be behind, is busy endeavoring to eclipse the admirable exhibition of her manufactures inaugurated in 1872. We have been waiting to hear from Chicago, and our expectation is at last gratified. Rebuilt from her ashes, the "Garden City of the West" proposes to "celebrate" the second anniversary of her scorching by a grand Inter-State Industrial Exposition, which the *Land Owner* says is to be the "crowning glory" of that momentous occasion.

The building, which will be of a very ornate design, will occupy a portion of the lake front at the foot of Adams and Jackson streets, and will be 800 feet long by 200 feet wide. The main walls will be 24 feet high and composed of brick and glass, and the center will be surmounted by a dome 160 feet high by 50 feet in diameter. There is to be a grand art gallery, between which and the center of the building a large fountain will be placed. With the exception of the brick used in the walls, the entire superstructure will be built of glass and iron. It is the intention to have the edifice completed by September 1, so that a large force of workmen is employed and the work is being pushed forward as rapidly as possible.

In regard to the Exposition itself, the programme will soon be issued, and it may be sufficient to state at present that the plan embraces a representation of the products of every branch of art, including liberal and fine arts; the processes and products of every species of manufacture, together with collections, models, drawings, etc., illustrative of the sciences. No more comprehensive scheme could be devised, except that it does not include live stock, nor such operations and processes relating to agriculture as require to be conducted and shown in the open air. It is intended to be a reflex, not only of practical art and manufactures as they are found in this country, but, to a large extent, of those of Chicago, as shown in her trade and commerce.

Mr. Potter Palmer is president of the company managing the enterprise, and a large number of the leading citizens of Chicago are included among the officers and stock holders.

FREIGHT BUSINESS OF NEW YORK CITY ACROSS THE NORTH RIVER.

The amount of produce and general merchandise constantly being moved to and from New York city is so great that any statement of the business, by simply giving totals, can hardly be taken in by those unaccustomed to the vastness of the commercial transactions of the present day. The money represented, in the moving merchandise which constitutes the basis of the commerce of New York with foreign countries alone, is briefly told in the statement that the declared value of the imports and exports at the port of New York is upward of eight hundred millions of dollars annually; but in this estimate, of course, the vast amount of freight which is annually handled in supplying the wants of home consumers as furnished by home producers is left entirely out of the question; and this, it is safe to say, is in bulk, as it is probably in value, far greater than the traffic directly connected with the export trade.

Aside from the highly important arteries of communication which connect New York by rail with the north directly and thence west over the Hudson river at Albany, and those which perform the same work as between the commercial metropolis and the New England States, as well as the great extent of water transportation up the North river and thence through the Erie and other canals, the shipping in the Sound and to the south, along the Jersey shore or through the canals in that State, Delaware, Maryland, Pennsylvania, and southern New York—apart, we say, from all these facilities, all of which make it most convenient to land goods on New York piers and at the doors of its warehouses: there are the more important lines of railways, stretching west and south in every direction over the country and all having their proper termini on the west shore of the North river, whence their goods must be re-handled for shipment over the river, or the cars towed over on floats built for that purpose. This not only involves delay, but the expense for transportation over so small a portion of the route is great, vastly beyond comparison with that on any other portion of the distance reached. .

The principal railroad lines which are situated to deliver their freight naturally on the Jersey shore are the Erie, the Pennsylvania railroad—which runs the Camden and Amboy and the New Jersey railroad—the New Jersey Central, and the Morris and Essex railroads. The total amount of freight delivered daily, as well as that taken westward, varies greatly, as many as fifteen hundred cars coming in on some days, with as many going out; while at other times there will not be more than one third of this business. As these roads have connections all through the South even to Texas and through the west to San Francisco, it is obvious that the freight which they carry must include almost every kind of merchandise known; it is, also, equally apparent that, where there is competing water transportation, by canal or river, the more bulky and less costly articles will take the cheaper way, thereby reducing the amount of freight deliverable or taken by these channels when the canals and rivers are open to navigation; and so nearly the entire coal production of the country is brought forward to tide water or taken to its principal destinations inland by water.

For the vast amount of freight coming and going from New York by rail, however, the methods of its handling and shipment over the river have changed very little for some years past,except in the increased accommodations which the rapid growth of the business has called for. The Erie railroad company does not now, as formerly, run any cars to New York city, the whole amount of its freight being reshipped, on canal boats, barges, and lighters, to the delivering points in New York. The number of cattle daily received by this road is very great, and it has extensive cattle yards at Weehawken, about four miles above its main depot at Jersey city, with a track running there, whence the cattle may either be taken by the cattle barges or be driven by droves across by the ferry landing at 42d street, New York. As might be expected the cost of transportation over the river forms a considerable item in the running expenses of the road, not including the extra handling, which must increase the amount by at least fifty per cent, being reported at $184,514 for the year 1869; though from this sum must be deducted the profits of the Pavonia ferry, the gross earnings of which for the same period were $34,523.

On the barges now used by the Erie company 8,000 barrels, or 80 car loads, of flour can be transported at once. On some days 200 car loads of flour alone have been delivered by this road at Jersey City. For other kinds of freight the facilities would be comparative both as to bulk and weight. For a car load of cut meats, such as hams, shoulders, bacon, etc., 36 packages is the rule, or fifty barrels of whisky, or about 1,000 sides of leather, etc.

On the Pennsylvania railroad, which runs the Camden and Amboy and the New Jersey railroads, nearly all the freight, and all of that brought by fast express lines running over the road, is delivered in New York without breaking bulk. The cars are run on what are called car floats, carrying eight to ten cars each—four or five on a side—and these are towed over to the depot on the New York side, and taken back in the same way. These car floats are simply large, square built, flat boats, and not very expensive; but as the business of this line and its connections is very heavy, and it also includes the Delaware and Raritan canal, quite an extensive fleet is needed for its business, which includes four freight steamers, fourteen towing steamers, six freight barges, ten car floats, twenty schooners, twenty-one coal barges, and seventy seven canal boats.

The New Jersey Central and the Morris and Essex railroads, also large carriers of freight to and from the New York market, do not run any cars over the river, although there are several fast freight lines running over the former road under special contracts, which have their cars floated over the river by the same means as the Pennsylvania road, so that they do not break bulk until reaching New York city. The bulk of the carrying, however, on these roads, between New York and the Jersey shore, is by means of canal boats, lighters, barges, and freight steamers.

It might be supposed that no small proportion of the freight delivered and taken by these roads would be accommodated or supplied from the large number of ocean steamers which now have their landings on the Jersey shore, thus saving the expense of handling and shipping over the river; but this is true only to a very small extent. A very considerable proportion of their outward bound freight, especially in the summer season, is furnished direct by canal or steamboat lines from the interior, and substantially all that they bring here is first taken to stores in New York city, or to the bonded warehouses, whence it is subsequently withdrawn to the stores. That which is imported in bond for the interior might thus go forward, but the amount is too small to render necessary any special accommodations for it.

The total cost of passenger and freight ferriage for the use of railroads having their termini on the west bank of the Hudson can only be estimated, as these ferries also serve for the accommodation of a local business, though established and run mainly for their several railroads. There are eight passenger ferries, with boats running on each at intervals varying from ten to twenty minutes. Estimating the number of boats necessary to carry on this business, or counting the number of passengers at a fixed price each, we think we are quite within the mark in considering the cost of passenger and freight ferriage over the North River at fully two and a half million dollars annually.

THE AMERICAN INSTITUTE FAIR.

We call the attention of our readers to the advertisement in another column, announcing the opening of the forty-second Annual Fair of the American Institute, at the building of the association, on Third avenue, between 63d and 64th streets, in this city, on the 10th of September next. It will be noticed that a change has been made in the management of the exhibition, and that the usual communications are to be addressed to the general superintendent, Mr. Charles W. Hull.

We take the present opportunity to urge upon inventors and manufacturers, intending to contribute, to lose no time in preparing their exhibits, securing space and completing the necessary preliminary arrangements. There is no excuse for the state of chaos which has marked the opening days of the Fairs of the past four or five years. Timely notice has this season been given, and if exhibitors do not take advantage of it they must ascribe the unfinished condition, lessened advantages, and consequent temporary lack of public interest in the exposition mainly to their own neglect.

A New Fire Escape.

A new extension ladder for enabling firemen and others to enter and escape from burning buildings was recently tested in the City Hall Park in this city. A ladder is set on a four wheel truck and is composed of sections ranging from eight to twelve feet in length, and stands independently of any building. The sections are mortised together and fastened with bolts and pins in a horizontal position. When secured they are raised perpendicularly by cog wheels and ropes,and the truck is made steady by suspended weights that may be increased at will. Two of these aerial ladders were experimented upon, the longest one of which reached 125 feet, was about three feet wide at the base and tapered to eighteen inches at the top. The rungs were a foot apart, and side fastenings were arranged to form a rail when the sections were united. It took seven and a half minutes to place the apparatus in working position. By means of a block and fall on one of the sections, a fireman was hoisted in a canvas bag to the roof of the City Hall,and afterwards a lead of hose was carried up, strapped to the joints, and a stream thrown from the summit of the ladder. The tests were quite successful, though rather abruptly terminated by one of the firemen falling and sustaining severe injuries. The invention is the property of Mrs. Scott Uda. an American lady, the wife of an Italian gentleman, and was first introduced in Milan, Italy.

SCIENTIFIC AND PRACTICAL INFORMATION.

NEW STEERING DEVICE FOR WAR VESSELS.

Mr. N. Scott Russell proposes to place the tiller or yoke under the water and connect it through tubes to the steering apparatus. The advantages to be gained by this arrangement are complete protection of the tiller from shot, the tiller can be made of any length, and the afterpart of the vessel need not be armored, thus lightening the ends and leaving a great weight to be disposed in thickening the armor over the vital parts of the ship, or increasing the amount of coal to be carried.

NICKEL.

Within the past three years, more especially since the discovery of practical methods for electro plating with nickel, the demand for this metal has greatly increased, and its price has advanced. It has risen from $1 to $3.75 per lb., and its expense has become so great that a substitute for it in the arts is now sought. A good substitute, it is stated, may be found in the metal manganese. Dr. Percy, in a letter to the London *Times*, states that 20 years ago he made an alloy in which manganese was used in place of nickel, and the resemblance of the alloy to the ordinary German silver was perfect. Copper 75 per cent, manganese 25 per cent, makes an alloy resembling German silver, and better in its qualities. By the improved process of Hugo Tamm, heretofore described in the SCIENTIFIC AMERICAN, manganese may be much more cheaply produced than nickel.

EXPERIMENTS ON THE RESPIRATION OF FISHES.

M. Quirquand arrives at the following conclusions: 1st. The quantity of oxygen absorbed is proportional to the unit of time. 2d. The relative power of respiratory labor in fishes diminishes with the weight. 3. The species has but little influence on the activity of respiration. 4. Carps of two pounds weight breathe from seven to nine times less than man, for the same period and unit of weight of living substance. 5. Fishes have a cutaneous respiration, as recognized by Humboldt and Provencal, but it is feeble.

THERMO-DIFFUSION.

M. Jedderson says, in *Poggendorff's Annalen*, that if a porous body be made in the form of a diaphragm and each face be exposed to a different temperature, a current of gas is immediately formed from the colder to the hotter side. The author considers this phenomenon as entirely differing from ordinary diffusion, and proposes to distinguish it by the name heading this paragraph.

NEW WOOD CARVING PROCESS.

M. Lanteigne, says *Annales Industrielles*, has invented a machine for producing wood carvings at the rate of a yard a second, and at a cost of about one per cent of those executed by hand labor. The operation consists simply in passing the wood between cylinders forming matrices. The material, it is stated, is not deformed, and greater density is given to it by the pressure, while the sculpture is as delicate as that made by the chisel. The process can be used for producing cornices, furniture decoration, and similar ornamental work.

TRANSMISSION OF PHTHISIS PULMONALIS THROUGH DIGESTION

M. Colin says that, after experimenting upon some thirty animals, he has determined very clearly that the idea that *phthisis pulmonalis* can be transmitted through using the flesh of animals affected with tubercular diseases is erroneous. Such maladies are never inoculable through the digestive organs, and hence the employment of the meat of phthisic animals does not offer the danger generally supposed.

PURIFICATION OF HYDROCHLORIC ACID.

M. Engel introduces, in 1·06 quarts of hydrochloric acid, 60 to 75 grains of hypophosphite of potash dissolved in a little water. After an hour or two the liquid becomes yellow and then brown, and a precipitate is deposited more or less abundant according to the degree of impurity of the acid. At the end of about forty-eight hours, the deposit ceases and the clear liquid above is decanted off and distilled. The acid thus obtained is completely free from arsenic.

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SILKWORMS.

We continue, from our paper of August 17, 1872, the series of illustrations of silkworms which feed upon the oak, and which are now being acclimated in the United States. Our illustrations and description are from the fourth Annual Report of Charles V. Riley, State Entomologist of Missouri.

THE YAMA-MAI SILKWORM—*Attacus* [*Antheræa*] *Yama-mai*, Guér.-Mén. (*Lepidoptera, Bombycidæ.*)

This worm is a native of the northern parts of Japan. It feeds on a species of oak known botanically as *Quercus serrata*. Its silk is produced in large quantities in its native country, and already forms an article of export. It has been found more difficult to acclimatize than the ailanthus worm, and but indifferent success has attended its culture. Yet th re are striking exceptions, and in Austria it has been successfully reared in considerable quantities for several years. It is, withal, so valuable an insect that further trial is fully justified. In America it has been experimented with only since 1868.

Mr. W. V. Andrews, of New York, who has taken great interest in the introduction of foreign silkworms, gives me the encouraging information that, in 1871, nearly 800 cocoons were obtained from about 1,600 eggs, in the vicinity of New York.

Yama-mai undoubtedly belongs to the same natural genus as *Polyphemus*, which it closely resembles in habit and appearance. Its culture may be carried on in the same manner as that of *cynthia*, and it will suffice here to point out such of its peculiarities as will guide in its management.

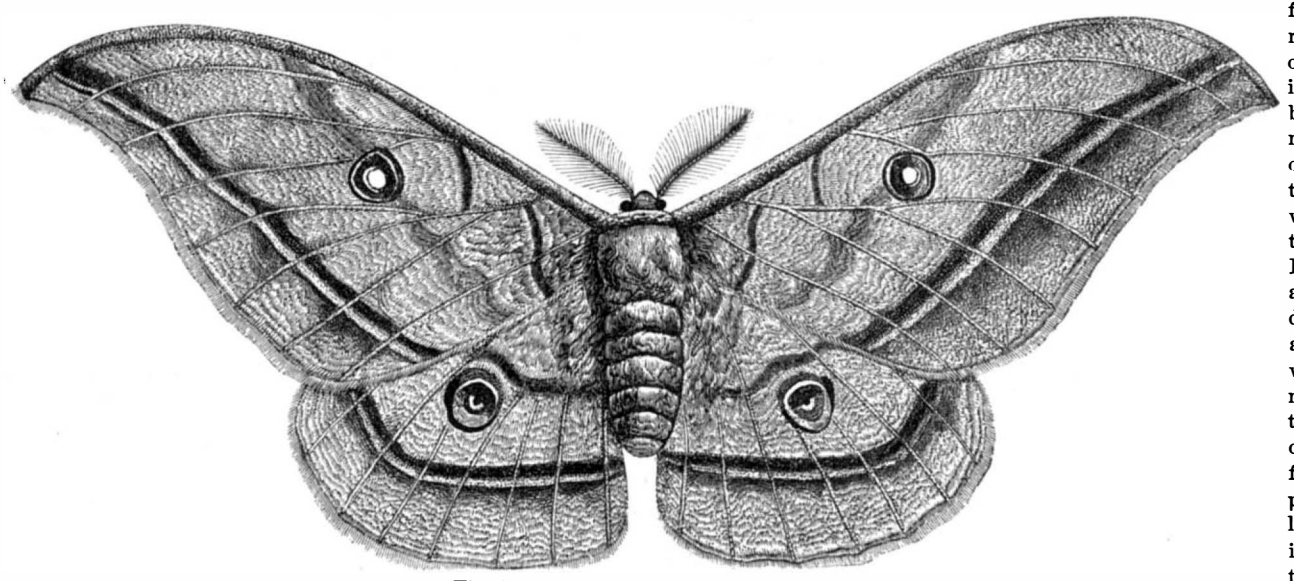

Fig. 2.—THE YAMA-MAI MOTH, MALE.

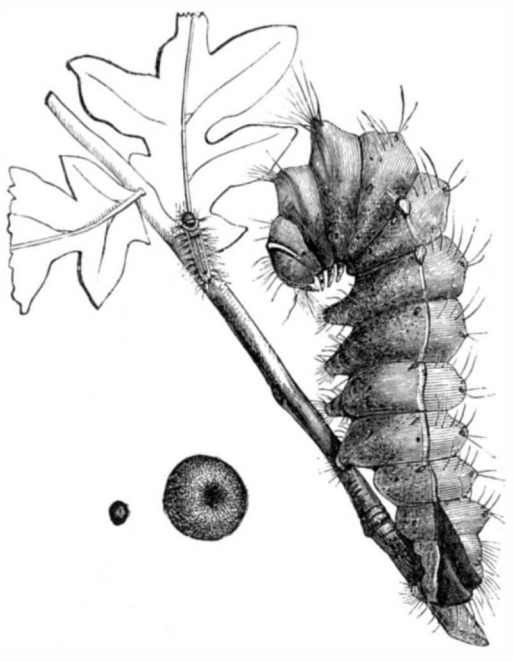

Fig. 3.—THE YAMA-MAÏ SILKWORM.

The egg is rather larger (Fig. 3 shows it of natural size and magnified) than that of *Polyphemus*, less flattened, and of a pale straw color with a pinkish tint. It appears brown from being more or less thickly coated with a brown tena cious gum, which may be washed off by any alkaline fluid. The eggs should be kept over winter in a temperature never higher than 40° Fah. When hatching they should be moistened or kept in a moist atmosphere. As in the case of our American tent caterpillar, the young larva is fully developed within a month after the deposition of the egg, and passes the winter in a curled-up, quiescent state within the egg shell.

The worm thrives best in an atmosphere that is cool, moist, and shady, and the heat, if it can be controlled, should not exceed 80° Fah. It is a lazy slothful creature, and often rests for hours in the position given in Fig. 3. As we learn from Mr. F. O. Adams, who has made an interesting report on the culture of this species, the color of the more mature worms so thoroughly corresponds with that of the leaf on which they naturally feed that they can with difficulty be detected while clinging, motionless, to the branches and leaf stems. They are of a beautiful clear green, with generally two silvery spots each side on the fifth and sixth joints, and a pale yellow line running along the sides. This line, with the position which the worm sometimes assumes, strengthens the resemblance to the leaf, and I reproduce a rough outline (Fig. 4) from Mr. Adams' Report, which will well convey this resemblance to the reader's mind—the worm being outlined at *a*.

The life of the worm lasts from 50 to 80 days, and it feeds on all kinds of oak, but prefers those of the white oak group. Dr. Alexander Wallace, of Colchester, England, to whom I am indebted for specimens of the moth, and who has extensively experimented with it, found that the worm would feed also on beech, apple, quince, white thorn, Neapolitan medlar (*photinia glabra*), and chesnut.

The cocoon (Fig. 1) is large, heavy, and handsome, and requires a full week for its completion. It is formed within a single leaf or within several drawn together and attached to a twig. It is oval and usually of a bright golden yellow color on the outside, though nearly white inside. Those raised out of doors are more green, while those raised indoors are more yellow, and white specimens have already been produced. The silk is strong and valuable; it bleaches well, and may then be dyed; fewer threads are required to make a strand than in that of *mori*, and it unwinds with perfect facility by the ordinary process. It shows its affinity to that of our *Polyphemus* by the gum which surrounds it containing a chalky or calcareous substance which may be noticed upon tearing or rubbing the cocoon.

The moth (Fig. 2, male) is magnificent in point of size and color. The front wings are broadly falcate, and more so in the male than in the female. The collar and broad costal margin are always of an ash gray. The eye spots are surrounded with more or less pink and yellow, white and black, the black always being on the outside. The broad lines across the wings are either wavy and slate colored, with an inner wavy coincident shade, or more straight with a whitish outer shade, relieved by a darker and more reddish posterior shade. The posterior margins are either paler than the general surface, or ornamented with a dark wavy line. The median shade across the front wings is either very distinct and scolloped, or obsolete; and there is either one or two such shades on the hind wings. The species varies, in fact, very much in the detail of ornamentation, and in general color, being either yellow, brown, grayish, or olivaceous, and some specimens much resembling certain forms of our *Polyphemus*.

According to the testimony of those who have had most experience with this species in Europe, coition invariably takes place at night, and lasts but a comparatively brief time. As the moths issue very irregularly and the males are apt to appear many days before the females, and as it has been further ascertained that unless they emerge within a day or so of each other, the sexes show little affinity, it is best to retard the male cocoons. This can be done by first separating them by weighing, and keeping the male cocoons in a cooler place than those of the female.

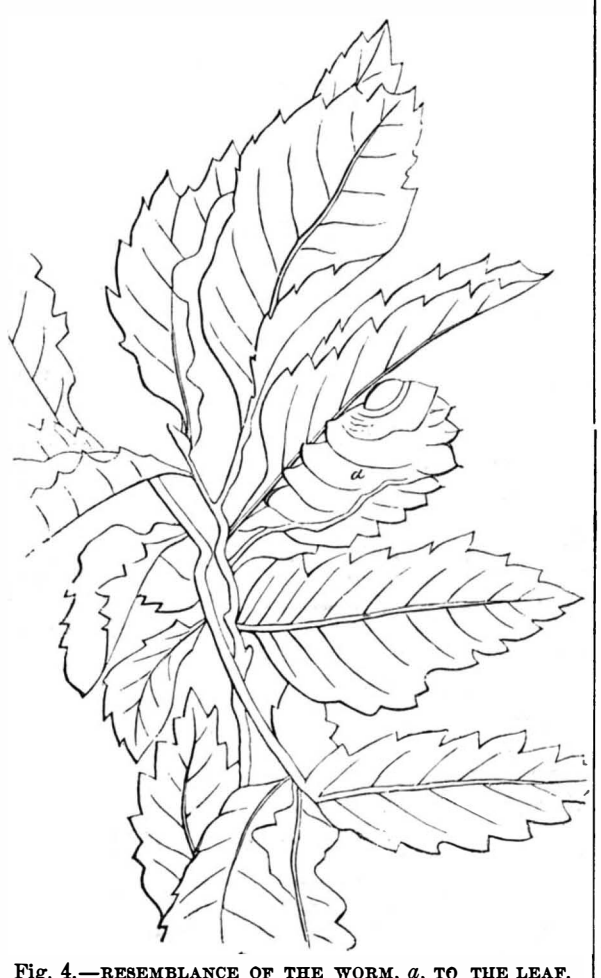

Fig. 4.—RESEMBLANCE OF THE WORM, *a*, TO THE LEAF.

From the foregoing it is evident that, while *yama-mai* is the most valuable silk producer next to *mori*, it is nevertheless very difficult to rear. It cannot well endure a heat beyond 80° Fah., and will doubtless thrive best in the more northern States, for it will bear a moderate amount of cold, even below freezing point, for brief periods, with impunity. It is invariably single brooded, and runs a longer course of life than any of the other species treated of. The hatching of the eggs must be retarded till the first oak leaves (the buds of the post oak are among the earliest to swell, but some species of the black oak group, especially the laurel-leaved oak, leaf out first) put forth; and moisture, which is prejudicial to the mulberry silkworm, is grateful to this one at all times. I have already said that the embryo larva is fully formed soon after the egg is deposited. Now all our eggs, so far, have been obtained indirectly from Japan *via* Europe, and in the transit they must necessarily be subjected to too much dampness and confinement, too great changes from heat to cold, and the reverse, and the vitality of the young worm thus impaired. Mr. Andrews believes that to this fact must be attributed much of our failure in this country, and I fully concur with him. In this country which, compared with Europe, is so rich in oaks and in the large silk-producing insects so closely allied to *yama-mai*, and which is so varied in climate, we certainly ought to meet with better success than our European friends; and until we procure eggs more directly, or obtain them from insects reared in this country, so as to preserve them in uniform and favorable conditions, it cannot be said that we have taken the proper steps towards acclimating it.

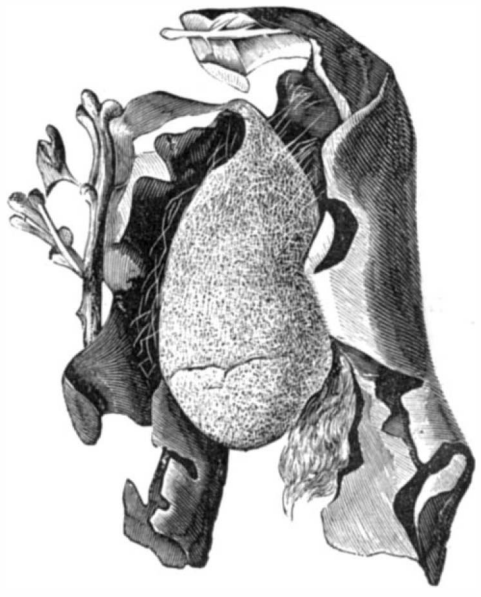

Fig. 1.—COCOON OF THE YAMA-MAÏ SILKWORM.

A Common Sense Decision.

Chancery proceedings were lately begun in London by the proprietors of a weekly newspaper entitled *The Iron Trade Circular* (Ryland's) to stop the publication of another journal entitled *Griffiths' Iron Trade Circular*. The Vice Chancellor delivered the following judgment: This is a motion for an injunction against the defendant to restrain him from continuing to publish a paper under the name of *The Iron Trade Circular*, and the motion is made on the ground that the plaintiffs are the proprietors, and have been so for eight years past or thereabout, of a publication, published every Saturday, which is entitled *The Iron Trade Circular* (Ryland's). Now, the doctrines of the Court upon this matter are very plain. When a name has been used and appropriated, whether it be the name of a newspaper or a book, or a mark on an article produced for the purposes of trade, the person who first uses or appropriates the name or mark is entitled to prevent any other person using the same mark or name. Therefore (by way of illustration), nobody could be permitted by the laws of this country to start a newspaper in London to be called the *Times*, because that is already appropriated and has long been appropriated by the proprietors of that well known paper. So with regard to the *Saturday Review*, which is also a well known name; nobody, therefore, could be permitted to bring out a new publication to be published weekly called the *Saturday Review*, because that name is already the property of other persons. Judgment for the plaintiff.

EFFECT OF STREET GAS ON TREES.—Experiments have been lately made, in the Botanical Garden at Berlin, as to the effects of ordinary gas on vegetation. Gas was conducted through pipes to the roots of various trees continuously for several months. The principal conclusion arrived at was that 25 cubic feet of gas, daily diffused through 576 cubic feet of earth, is sufficient to kill trees of any species, and the more quickly the more compact the upper layer of soil.

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IMPROVED PLOW.

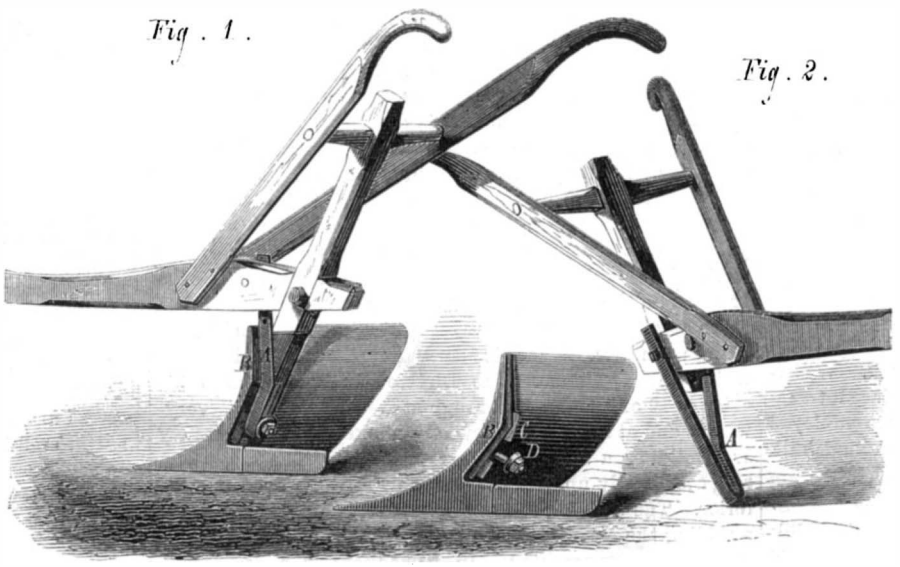
The principal advantage claimed for the invention represented in the accompanying engravings consists in the arrangement of the plow stock, which is so constructed as to be readily connected with any desired form of blade. For use on cotton and other farms where varying patterns of plowshares are necessary for different purposes, the economical value of this device is obvious. The farmer in purchasing this plow need only procure in addition thereto a suitable selection of blades, with one of which he is at once furnished in the efficient form of turning plow which constitutes a portion of the complete implement.

In Fig. 1 the blade and standard are shown connected, and in Fig. 2 the same are represented separate in order to represent the mode of attachment. The beam and handles are of the usual description. The standard, A, consists of a single bar of iron made into a loop with two diverging arms. One of the latter is bent forward edgewise, and both together act as braces. In securing them, the forward arm passes through and the rear arm is bolted to the side of the beam. Two or more holes in either branch allow of the adjustment of the angle of beam and standard to suit plow blades of different curves.

The cast turning plow is made with a shoulder, B, on the under surface of the mold board, and its under face rests on the front side of the loop of the standard, a projection, C, fitting in said loop. The object of the shoulder is to give the backward inclination to the mold board, and the purpose of the projection, C, is to assist a bolt, D, in uniting the mold board and standard immovably when needed for service. This modification of the mold board enables cast plows of any pattern or size to be adjusted to the standard, the latter of course varying in size, according to the power to be applied. A saddle with its under surface, modified as the mold board just described, is to be used when a wrought mold board turning plow is to be employed. In this case the saddle, on which is a land side, is introduced between the mold board and standard, and the same bolt passes through and secures all parts.

Among the additional advantages claimed for this device are that it is universal in its uses, is an efficient turning plow, and an excellent standard for a subsoiler. It can also be made at as low a price as any other good plow. The inventor is a farmer and has thoroughly tested the plow on his farm for a period of two years with uniformly good results.

Three patents cover the improvement, the latest of which is dated Oct. 29, 1872. For further particulars regarding sale of rights, interest, etc , address the inventor, Dr. F. M. McMeekin, Orange Spring, Marion county, Fla., or Bent, Goodnow & Co., 84 Washington street, Boston, Mass.



THE UNIVERSAL STANDARD PLOW.

IRON SHIP CONSTRUCTION.

The progress of iron ship construction in this country has, of late, advanced so rapidly as to engender a reasonable hope that the time is not far distant when American-built vessels from the Delaware shall be as eagerly sought for, and, indeed, rival in the employment of the commerce of the world, the far-famed productions of the shipyards of the Clyde. With every resource of material, machinery, and skilled labor abundantly at our command, there seems no obstacle to the speedy furtherance of an industry than which none bids fairer largely to augment our national prosperity; and if the owners of our merchant marine will, by their substantial encouragement, foster the enterprising spirit now manifested by many leading firms, there remains little doubt but that our now dilapidated commerce will soon regain if not exceed the proud proportions which it had attained before the outbreak of the war.

In the following description, though necessarily brief and general in detail, it is proposed to give an outline of the method of proceeding with the work of building iron ships. We are indebted for the facts and illustrations to a new volume, recently published by Messrs. John Wiley & Son, of this city, entitled "An Outline of Ship Building." The book, we may here remark, is a thorough and careful exposition of the whole theory and practice of the subject to which it is devoted, and emanates from the pen of Assistant Naval Constructor Theo. D. Wilson, U.S.N., an officer of well known experience and ability.

PREPARATORY WORK.

As soon as the drawings have been completed, a model of the ship, on a scale of half an inch to a foot, is prepared, on which the general arrangement of the edges and butts of the plating, the directions of longitudinal work, deck lines, etc., are marked. Simultaneously, the laying down of the ship is proceeded with, that is, the different parts of the vessel are delineated in their full size upon the mold loft floor. This completed, the lines, to which the angle iron frames are to be bent, are transferred to boards prepared for the purpose and razed in. There are two of the latter, each being large enough to take the midship section, the fore body being transferred to one and the after body to the other. In order to show these lines more clearly the upper surface of the "shrive" or shriving braids, as they are termed, is covered with a composition of lamp black size and water. Beside the lines to the outside of the frame, the position of the plate edges, diagonals, level lines, hights of floors, beam ends, etc., are also marked upon the boards, which are then removed to a place near the furnace in which the angle irons are heated.

BENDING THE ANGLE IRONS

for the frame is the first operation. The leveling blocks or bending slabs on which this is done are made of cast iron, the upper surface being straight and out of winding, and perforated with holes placed at intervals of about six inches. The line to which the frame is to be bent is transferred from the blackboard to the slab by means of a soft iron bar, known as a "set" iron, which is bent to the line on the board, has the beveling spots, etc., marked upon it, and is then removed to the slab on which the curve is drawn and the spots are marked. After the bending and beveling are completed, the angle iron is allowed to cool, and is then taken to the blackboard and tried to its curve, any unfairness or alteration of form, which may exist, being set right. The holes are next punched and a final trial of the curve finishes the work.

KEEL, STEM, STERN POST, AND BEAMS.

While the frames are being prepared, the keel is proceeded with and temporarily put together on blocks alongside the dock or slip where the ship is to be built. After it is set up, the frame stations are painted upon it, when it is taken apart and again put up permanently and riveted in proper position. The stem of an iron ship is generally a prolongation of the keel; the iron stern at present in use in ordinary iron vessels is simply a curved solid bar of uniform section, or nearly so, generally forming the contour of the bow. In war vessels, the first thing to be accomplished is to give to such a stem the support of all the bow, bottom plating, and armor plating, to deliver a horizontal blow, and for this purpose all such plating is let into the substance of the stem, abutting squarely against the fore side of a rabbet. The stems of all the English iron-clad frigates are formed of the best scrap iron under the steam hammer. They were bent on beveling slabs used for forming ship frames as above described, a coke fire being made around a length of about eight feet at a time. When the heat was sufficient the fire was removed, and the bending effected by means of wedge sets, tackles and crabs, and other like appliances. The operation was repeated until the whole length was brought to the required shape.

The sternposts of iron ships admit of the same variety as keels and stems. Solid bar posts are now used, being scarfed or welded to the keel in th same manner as the stem is secured.

The form of beam now commonly employed, especially for upper deck beams, is known as the Butterley patent welded beam. Up to 12 inches in depth, it is rolled in one piece; above this dimension, the bulb half is rolled separately from the upper or T half, and the two are welded together along the neutral axis of the beams. While the frames and keel of the ship are in progress, beam molds, with the spring and length marked upon them, are given to the workmen to guide them in making the beams. The processes of bending and straightening the latter are performed by means of screw presses worked by hand or hydraulic power, the metal being cold. In forming the beam knees the ends are the only parts put into the fire, and the plan adopted in nearly all instances is to split the beam arm for a short distance, turn the lower part down, and weld a piece of plate iron in.

FRAMING.

When the keel has been fixed in position on the permanent blocks, the frame amidships is first put up, and the work is continued fore and aft simultaneously. Stages are then made around the ship at different hights for the purpose of proceeding with the plating, the latter operation being commenced as soon as the frames are regulated and secured in place.

In the meantime the floor plates, shown in the engraving Fig. 1, on the inside of the vessel nearest the keel are prepared, and holes made in their upper edges for the reversed bars. The riveting up of the latter and the floor proceeds simultaneously, as, indeed, now does all the work connected with the construction of the ship.

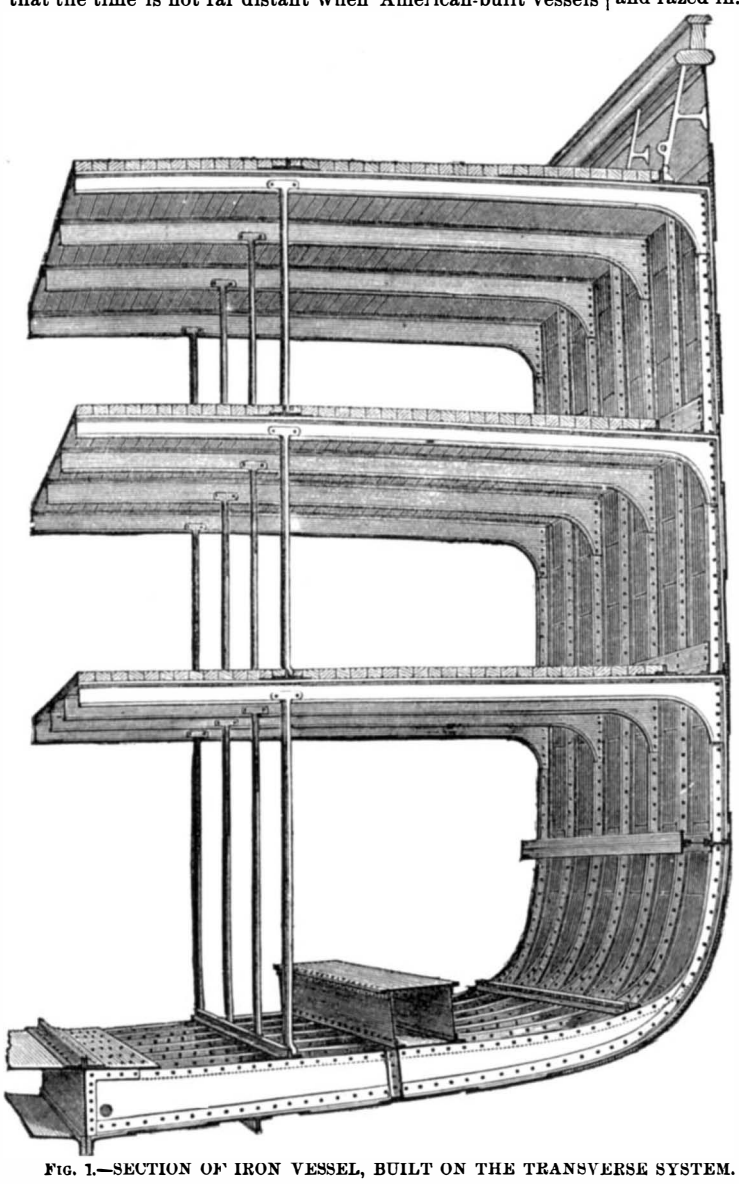


FIG. 1.—SECTION OF IRON VESSEL, BUILT ON THE TRANSVERSE SYSTEM.

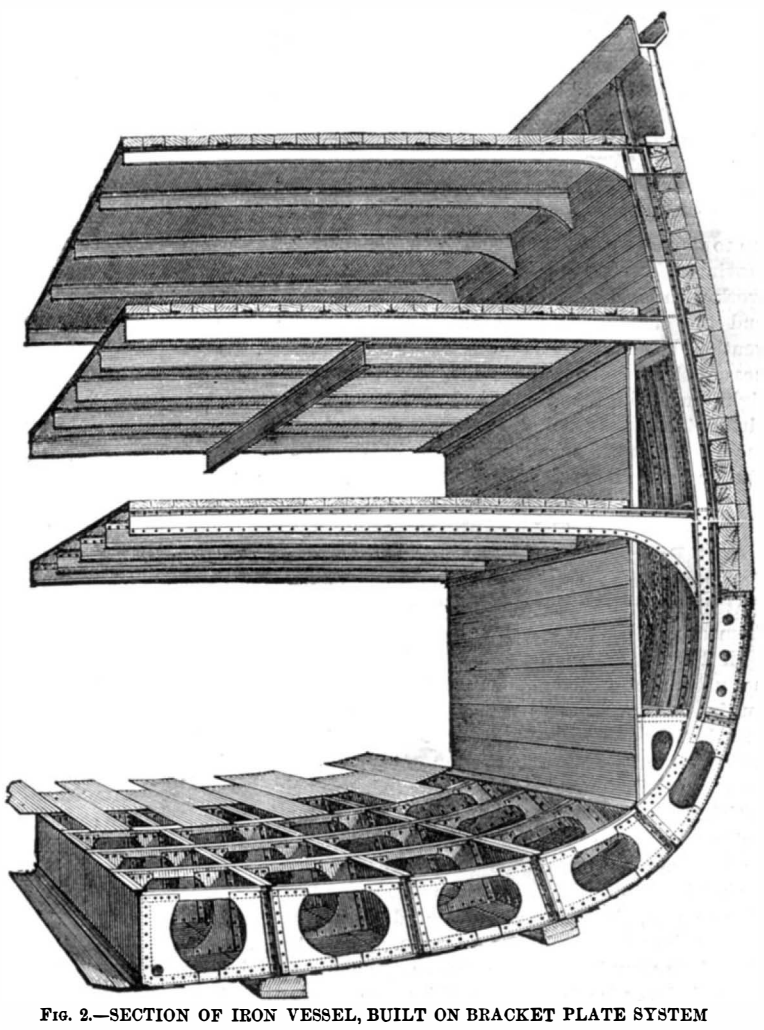


FIG. 2.—SECTION OF IRON VESSEL, BUILT ON BRACKET PLATE SYSTEM

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PLATING.

A strake is a breadth of plank, or, in iron vessels, plating wrought from one end of the ship to the other. According to the plan now in general use, each alternate strake is worked directly on the frames and the intermediate strakes form an outer layer, each of which overlaps the edges of the two adjoining strakes. This will be rendered clear by a glance at the section of the exterior plating, as shown in Fig. 1. The lowest strake is generally an inside strake and is first put on, the work being continued upward. After holes have been punched each plate is curved by passing it through rolls, and is then put in place and temporarily secured. Pieces filling up the space between the frames and outside strakes, called "liners," are fitted after the plates are prepared and fixed. While the plating is thus proceeded with, the work on the interior of the ship is also advancing; the riveting of the reversed angle irons and floor plates being completed, the beams being got in and fastened, the deck and hold stringers being fitted, fastened, etc. The edges and butts of bottom plating are generally double chain riveted, but in some cases treble chain riveting is employed for butt fastenings.

FINAL OPERATIONS.

The deck planking is of wood, almost invariably, the planks being usually secured by a screw bolt driven down from above with a nut underneath the iron deck. Watertight bulk heads, in iron vessels, are always placed transversely, and in some cases longitudinal divisions are employed in addition. In many steam ships the longitudinal bulk heads enclosing the coal bunkers are made watertight.

After working about three fourths of the outside plating, men are set to work closing up the joints, reaming out unfair holes, etc., preparatory to riveting. The latter is done by piece work, a set of riveters being two riveters, a holder up, and two boys to carry the rivets. Care is taken that the holes are well filled and the points of the rivets flush with the surface of the plates. When this work has advanced to some extent, caulking of the butts and edges commences, the closeness of the joints being first tested by trying to insert a thin steel blade at various points. Lastly the painter follows, and the vessel receives coatings of red lead which prevent oxidation of the finished portions.

BRACKET PLATE SYSTEM OF FRAMING.

In Fig. 2 is represented a section of H. B. M. frigate Bellerophon, showing a system of framing universally used in the construction of heavy armored vessels in Europe. It has been recently introduced in this country and has been first employed in the torpedo boat now in process of construction from the designs of Admiral Porter at the Brooklyn navy yard. The difference in the mode of construction is apparent by a comparison of the two illustrations.

Prevention of Artisans' Diseases.

In a recent lecture by Dr. Mapother, on the subject of the prevention of artisans' diseases, he said that the special diseases which ill regulated trades induce may be placed under three classes: 1. Those due to the entrance of dust into the lungs: 2. Those due to slow poisoning: 3. Those which constrained positions or overwork in close rooms engender. Stone cutters suffer from lung affections by inhaling minute particles of stone, which irritate the lungs and excite inflammation. The working of flax is also very detrimental, giving rise constantly to asthmatic complaints. At paper works the teasing of the shoddy, and at marine stores the picking of rags, create a most stifling and hurtful dust. The remedy for dusty trades was, first, to use a respirator which would filter the air. He had devised one some years since which was found to be very effectual, and cost only a few pence. It consisted of a wire gauze covering the mouth and nose, lined by a layer of cotton wool a quarter of an inch thick. Other remedies were ventilation by means of McKinnel's tube; the action of steam fans; and the peremptory exclusion from all labor requiring vigorous muscular and breathing efforts, of persons under eighteen, whose organs up to that age are not strong enough to resist ill-usage. Having referred to the diseases which occur among those who work with lead, copper, mercury, phosphorus, and arsenic, and the chemical and mechanical appliances for their prevention, he alluded next to the case of seamstresses. Weakness of sight, from over-use of the eyes. with badly arranged light, and indigestion, from bad and hasty meals and long sitting in a close room, are diseases which have been commonly observed among needle workers, who number in Dublin between seven and eight thousand.

The Telegraph in Austria.

G. B. Prescott Esq., the electrician of the Western Union Telegraph Company, says, in the *Journal of the Telegraph*, that in Austria a telegraph system constructed differently from any on the continent is found.

In France, Belgium, and North Germany, cross arms are not used, the insulators being fastened directly to the poles, but in Austria the cross arms again appear. They consist of round sticks of wood, of about three inches in diameter, apparently the natural timber with the bark taken off, and unpainted. When many wires are carried, two poles are used, which are joined together at the top and separated at the bottom about five feet, thus forming what the English call an A pole. The cross arms are alternately fastened upon each side of the pole, as they are in England, a preferable plan to ours, where they are all placed on the same side. In Vienna the wires are carried on iron poles, no underground wires being employed either here or in any part of Austria. The pole is made of cast iron, and is very ornamental. It consists of an iron column about twenty feet in hight and one foot diameter. The lower end is screwed to a stone base. At the top of the column a horizontal arm extends about two feet on either side, and from the ends there extend two vertical shafts fifteen feet in hight, thus constituting an iron column with two branches, resembling a candlestick holding two candles. The two upper shafts support eight iron cross arms, and each cross arm carries eleven wires, so that each pole carries eighty-eight wires. The poles are about one hundred and thirty feet apart. The Government has only one office in Vienna for transmission of despatches, but it has eleven offices at which messages are taken in, and from which they are sent to the transmitting office by messengers. There is a private company, however, the "Wiener Privat Telegraphen," which has about sixty stations in Vienna and forty in the vicinity.

The Austrian territory is divided into two telegraphic zones. The charge to the first is 40 kreutzers, and to the second, 60. The male operators receive from 600 to 1,000 guldens or florins ($300 to $500) per annum. The female operators from 250 to 350 florins (from ($125 to $175) per annum. In addition they both receive half a kreutzer (quarter of a cent) per message as a commission for their work when employed on the Morse, and three quarters of a kreutzer on the Hughes. The number of employees to do a given amount of work is always strikingly greater in Europe than in America. There is none of that hurry and bustle which we see at home. The Director General comes to his office at 12 or 1, and gets through at 3. In the offices, everywhere and at all times, everybody smokes. In Vienna they are building a splendid telegraph office. The walls and roof are already up, and they are now at work upon the interior. The building is five stories, and is built of stone, resembling the Nova Scotia freestone but of a better quality, and highly ornamented. In front there is a sculptured figure of Time and a group representing the telegraph. The building will cost 800,000 florins, or $400,000. It is square, and has an inner court also square, and admits light from four sides, without and within. The operating room is on the top floor, and occupies three sides of the building. On the opposite side of the street they are erecting a splendid exchange and, adjoining it, a new post office. These are to be connected with the telegraph by a pneumatic tube, and a pneumatic tube will also convey the messages to the operating room from the receiving office.

Preparation of Chlorates for use in Calico Printing.

It has heretofore been customary, in preparing the various chlorates, to first decompose the chlorate of potash with tartaric acid. The cost of the latter, however, made them more expensive than the chlorate of potash from which they were made. Schlumberger now uses the sulphate of alumina for decomposing the potash salt, thus forming chlorate of alumina and alum, and from the former the other salts may be obtained, not in a state of purity, to be sure, but sufficiently so for printing. Ammonia, lime, baryta, soda. and even aniline, are able to decompose the chlorate of alumina, and combine with the chloric acid to form chlorates.

Chlorate of ammonia is obtained by precipitating the alumina with ammonia or carbonate of ammonia, and filtering. The solution will contain chlorate of ammonia with a little sulphate of potash and sulphate of ammonia, so that we find that Schlumberger's chlorate of alumina must contain also some alum.

Chlorate of lime is obtained by precipitating the alumina with milk of lime; and since sulphate of lime, which is formed at the same time, is almost insoluble, it settles and leaves the chlorate of lime purer than the ammonia salt.

Chlorate of baryta is made in a similar manner, and is the purest of all, for caustic baryta precipitates all the sulphuric acid present in the alum.

Chlorate of aniline contains also very little of the sulphate because of the insolubility of sulphate of aniline, and only the chlorate of aniline and a little sulphate of potash remain in the solution.

This preparation of chlorate of aniline without tartaric acid, seems to be very important in an economical point of view, since aniline black is now prepared from chlorate of aniline.

The chlorate of alumina is very acid and dissolves considerable hydrated alumina; hence its formula is uncertain. It also dissolves magnesia, and in this way a mixture of chlorate of alumina and chlorate of magnesia is obtained which is useful in printing with camwood.

CAT'S TAIL PAPER.—Among the novelties at the late Lyons exhibition were certain products obtained by M. Dupont, of Nismes, from the reed mace or cat's tail, a plant which is very abundant in marshy districts, and which has been utilized for mats, chair bottoms, baskets, etc. M. Dupont prepares the fiber by first boiling the cut and dried leaves several hours in an alkaline solution, then pressing them between rollers and washing. A specimen of yellowish, very fiberous paper made from the plant was exhibited. The fiber is yellowish, but it can be easily bleached, and takes dye colors readily. Some specimens of ropes and cords from this fiber were also exhibited.

TRAGACANTH MUCILAGE.—Take of powdered tragacanth, 1 dram; glycerin, 6 drams; water, enough to make in all 10 ounces. Rub the tragacanth in a mortar with the glycerin and then add the water. This will produce a mucilage at once of excellent quality.

HOW TO CLEAN BONES.—Soda ash, 1 lb.; lime (burned) ½ lb.; hot water, 3 quarts. Mix, and soak the bones for 24 hours in the liquid; wash them thoroughly and bleach them.

Correspondence.

The Diurnal Variation of the Magnetic Nsedle.

To the Editor of the Scientific American:

The diurnal variation of the magnetic needle has always been a perplexity to land surveyors. I cannot ascertain, from any authority I have ever consulted, what allowance per hour to make for it. I can only learn that the needle changes from east to west about fourteen minutes between 8 o'clock A. M. and 2 o'clock P. M. To supply this deficiency of the text books, I have experimented through three days with the following results:

My experiments were made with a surveyor's transit, with a five inch needle, read with the aid of a magnifying glass. As the following table shows, there is a great and unreliable lack of uniformity in the hourly change, both in the different hours of the same day, and between the same hours of different days.

By reference to the table, it will be seen that from 8 to 9 A. M. on May 16 the change was eastward, while, during the same hour on the 17th, it was westward. On the 16th, from 9 to 10 A. M. the change was westward, while during the same hour on the 17th the change was eastward. On 17th, between 3 and 4 P. M., the needle made a sudden change westward, after it had commenced to return east; and a like occurrence took place on the 16th, between 5 and 6 P. M. On the 15th, the needle began to return east between 1 and 2 o'clock P. M. On the 16th, it did not begin to return till between 2 and 3 P. M.: and on the 17th, it began returning to the east between 1 and 2 as on the 15th. There were no local causes to make the difference in the changes during the same hours. The weather was throughout the three days alternately sunshine and clouds, warm at noon and cool at morning and evening.

A. M.	May 15th.	May 16th.	May 17th.
8 to 9 o'clock	— —	1′ in 6½ minutes. West	1′ in 8½ minutes. East
9 to 10 "	— —	1′ in 12½ " West	1′ in 12½ " West
10 to 11 "	— —	1′ in 12½ " West	1′ in 13 " West
11 to 12 "	1′ in 12½ minutes West	1′ in 75 " West	1′ in 60 " West
P. M. 12 to 1 "	1′ in 18 " West	1′ in 19 " West	1′ in 36 " West
1 to 2 "	1′ in 6½ " East	1′ in 40 " East	1′ in 54 " East
2 to 3 "	1′ in 12 " East	½′ in 50 " East	½′ in 51 " West(!)
3 to 4 "	1′ in 39¼ " East	1′ in 30 " East	1′ in 28 " East
4 to 5 "	1′ in 10¾ " East	1′ in 9¾ " West(!)	1′ in 40 " East
5 to 6 "	1′ in 17 "	1′ in 15 "	1′ in 40 " East
6 to 7 "	— —	— —	1′ in 11 "

Are there any reliably recorded observations to guide a surveyor in the hourly change of variation?

Rockville, Ind. JNO. T. CAMPBELL.

The Effect of Electricity upon Metals.

To the Editor of the Scientific American:

The deterioration of metals is of interest as an economic question, as well as a fit subject for scientific research. As the health and longevity of human life have been promoted by intelligent effort, so also has it been deemed possible to resist the destructive influences which attack the metals that enter so largely into every department of industry. Of the various agencies sought to antagonize the oxidation of metals, especially iron and copper, none presents more interesting phases than electricity. Almost in the infancy of electrical discoveries, it was ascertained that galvanic action, in some unexplained manner, exerted a protective influence upon one metal at the expense of another when both were plunged in the same solution, effectually checking all oxidation of the protected metal, even under circumstances that would ordinarily suffice to rapidly destroy it.

A saline solution attacks iron or copper; but if a piece of zinc be attached to either, it is preserved, while the zinc is consumed. It was upon this principle that Sir Humphrey Davy based his plan for the protection of iron and copper-bottomed vessels from the action of sea water, a plan, however, which has not been found practicable for reasons which do not affect metals under other conditions. Napier considers the application of zinc to iron a barrier to corrosion: "Not only as a coating but from its more electro positive character, it protects it by a galvanic influence" Upon this subject, Faraday asserts that "zinced iron would no doubt resist the action of sea water so long as the surface was covered with zinc, or even when partially denuded of that metal; but zinc dissolves rapidly in sea water, and after it is gone the iron would follow." The same writer says: "As to voltaic protection, it has often struck me that the cast iron piles for lighthouses or beacons might be protected by zinc in the same manner that Davy proposed to protect copper by iron." Faraday's hint has been acted upon by the British Government, and perhaps by others, in the protection of the iron cables with which the buoys are moored in the English Channel and various British sea ports. M. Van Beck observed that a copper vessel, filled with sea water for forty-seven days, connected voltaically, by means of a platinum wire, with a plate of iron plunged in the same liquid, was preserved from all oxidation. De La Rive says: "A metal, copper, for example, may be protected against the corrosion exerted upon it by an acid or a saline solution, such as sea water, by associating it voltaically with a more oxidizable metal, such as zinc." M. Schönbein demonstrated, by a numerous series of experiments, that iron and copper oxidize in air, in water, and in a saline solution, as well when they are in contact with zinc as when they are not so, if there is no electric current; but that as soon as there is one established, the negative metal is no longer oxidized. Dr. Schorm found that iron plunged in nitric acid becomes negative to untreated iron, and acquires a singular property enabling it

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to resist the action of the strongest acid; commenting upon which, the editor of the SCIENTIFIC AMERICAN (March 16, 1872) ascribes the result of the experiment to electrical action and anticipates that "investigation may give us some new light on the subject of electrolysis."

Having thus based the statement of this protective principle upon the highest authorities, I will enter into the consideration of a phenomenon as valuable in the practical arts as it is instructive to the student and scientist: yet, unfortunately, as a distinguished writer has aptly expressed it, the subject "has occupied the attention of practical men for a long time; it is one of high importance; nevertheless there seems yet to be a great deficiency in our knowledge of the extent of this influence, and how and when it is effective." The object of this article is not to attempt an explanation of the unknown or to develop a new theory, but rather to invite attention to a principle in Nature which may be made of practical utility in many ways when better understood.

One new feature, not mentioned in any of the text books, has been developed by a single experiment which any of the readers of the SCIENTIFIC AMERICAN can try. It has been found that instead of making the metal to be protected one of the elements of the voltaic combination, it may be made simply the conductor of a current generated by an independent battery. Immerse a sheet of copper in a saline solution, and, instead of attaching zinc to the copper, connect the latter by wires to the poles of an ordinary galvanic battery; the result is that, so long as the electric current is maintained through the copper, the solution in which it is plunged is inert and will not attack it. This only corroborates, more forcibly than ever, the conclusions of the SCIENTIFIC AMERICAN and the other authorities quoted, that these phenomena are attributable purely to galvanic action; and it widens the field for future investigation. J. L. WAITE.

St. Louis, Mo.

Estimating the Power Transmitted by Belts.

To the Editor of the Scientific American:

On page 257 of the current volume of the SCIENTIFIC AMERICAN, you give two rules for estimating the power transmitted by belts. Not long since, some experiments were made, in a large woolen manufactory, to determine the amount of power consumed in working the machinery in several of the departments of the factory. Selected from a large amount of data obtained, the following, relevant to the subject under discussion, will, I trust, be found of interest to very many of your readers; and the importance of your hints in relation to the employment of a dynamometer ought to be placed, by it, beyond question:

From a 46 inch pulley, an ordinary horizontal 8 inch belt drives a counter line about 40 feet long, by a 20 inch smooth iron pulley; and from pulleys on this line, the picking machinery and fans for drying wool were driven. The 8 inch belt having been thrown off, a similar 8 inch one was employed to drive from the 46 inch pulley in nearly a vertical direction to the 24 inch leather-covered pulley of the dynamometer, about 6 feet distant from center to center. From the driver on the dynamometer (also leather-covered) a 6 inch new double belt ran on a 20 inch iron pulley, about 12 feet distant, on the counter line before mentioned, rising at about an angle of 30°. The new belt was put on with clamps and was considered tight. It transmitted, without difficulty, 13·9 horse power at a speed of 1,130 feet per minute. Adding 2·19 horse power, the belt slipped so that speed could not be obtained. Three inches were then taken out, the belt becoming quite taut, not more so, however, than is quite usual on woodworking machinery. It would then transmit 17·27 horse power without any appearance of slip whatever. By the formula given, the 8 inch belt would be rated at 3·875 horse power. By actual test it was found equal to more than four times the estimate. An 8 inch belt could not be made to drive from the dynamometer on to the 20 inch smooth iron pulley on the counter line. By the same formula, a 6 inch belt would be rated at 2·53 horse power, and a double belt at 3·8 horse power (adding one half for a double belt). The common millwright's rule in this instance is much nearer the truth, and that estimate, 8·22 horse power, is less than one half the power actually transmitted.

The best possible conditions under which a belt can be used is when running horizontally, with the draft on the under side of the pulleys, and, of course, the slack or sag of the belt on top; thus wrapping a little more of the circumference of both pulleys when at work. On the contrary, a vertical belt, if of considerable length, is always in difficulty without a tightener. A. M. SWAIN.

North Chelmsford, Mass.

A Hailstorm at St. Louis, Mo.

To the Editor of the Scientific American:

A severe hail and rain storm took place here on May 19, 1873. All day the weather had been sultry, and at about 3·30 P. M. the thermometer registered 85° Fah. Just then, it began to rain, and soon the hail came pelting down thickly and fast, with an occasional heavy dash of rain. In eight minutes the thermometer fell 24°, and, in twenty-five minutes after the thermometer was at the maximum of 85°, it fell to its minimum, 57°. The storm came from the southwest, and was a thunderstorm, with hail and rain. The wind was from the southwest when the storm began, but suddenly changed around to the northwest and then to the northeast. Many of the hailstones were of extraordinary size; one weighed over half a pound when it fell, for it weighed 6½ ounces 3½ hours after the storm was over. At the time it was weighed, it measured 3½ inches wide by 1¾ inches thick.

St. Louis, Mo. GEORGE W. ALLEN.

The Concentration of the Sun's Heat upon the Earth's Surface.

To the Editor of the Scientific American:

On page 309 of your current volume is illustrated a theory on the above named subject, in which it is claimed that the atmosphere acts as a concavo-convex lens, by which the sun's rays are concentrated upon the surface of the earth. To my mind, this cause is quite insufficient to produce the great difference of temperature between the higher and lower strata of air, and for these reasons: The extent of the atmosphere above the earth's surface (supposed to be 50 miles) on all sides, viewed in its ratio to the earth's size, is as 1 to 80; hence the earth can obtain no more rays of solar heat with its atmosphere than it would if $\frac{1}{80}$ were added to its diameter and it had no atmosphere; and this would be quite insignificant. If the depth of the atmosphere bore anything like the proportion to the earth's size as it does in the illustration to the article, the case would be quite different. If the writer will draw his figure in true proportions, he will see at once that the heat rays have so very short a distance to traverse, after being refracted, before they reach the earth's surface that their convergence is imperceptible. I see no more mystery in the accumulation of heat on the surface of the earth than I do in the accumulation of snowflakes there. While in mid-air they are not arrested, and this is precisely the case with the rays of heat; they accumulate only where they are arrested by some more or less solid substance.

The low temperature of lofty mountains has sometimes been attributed to the rarity of the atmosphere through which the rays pass, by which the heat fails to be intensified, as it is supposed to be in some mysterious way when passing through denser air; but I think a more probable cause is simply that, so very small is the area of space where the rays are lodged, being surrounded by so vast a body of cold air continually floating upon it from all sides, the heat is carried away as fast as it is received; but on lower ground, where the rays are being retained for thousands of miles on the same plane, the heated air simply moves from one locality to another, the mass remaining nearly of the same temperature. The clear atmosphere is evidently not perceptibly warmed by the passage of the sun's rays through it, but rather from its contact with the earth and solid substances on its surface where the rays are arrested; and thus, as this heated air rises constantly, mingling with cooler air above, there is secured the most beautiful system of circulation which even the Infinite Wisdom could devise.

Milford, Mass. E. BROWN.

Horse Power.

To the Editor of the Scientific American:

Seeing a communication on page 320 of your current volume, on the power of horses, I am reminded of some notes which I took of the work of a pair of horses cutting wood at a railroad station. They weighed 2,000 pounds, 1,000 each, and worked on an endless bed power machine, such as is used in New England for threshing grain. The bed was raised so as to incline 3½ inches to the foot, and ran at the rate of 105 feet per minute, making a rise of 28½ feet per minute, which of course is equal to 2,000 pounds falling 28½ feet a minute, which would make 57,000 foot pounds per minute, including friction, which in that class of machinery would be enough to make it up to 66,000 pounds, the standard of two horse power. This amount of power would cut, with the ordinary sawing arrangement, 15 cords of mixed wood (hard and soft, 4 feet long), 2 cuts, in 10 hours and do it day after day.

The horses were not harnessed, but merely tied by a halter, so that it was actual weight that drove the saw. It was so good an illustration of the power of a falling weight that, being very much interested in such matters, I took down the figures, thinking that they might be of use or interest at some time, as a criterion to judge from in working or using the power of the horse. W. A. J.

Boiler Explosion at Syracuse, N. Y.

To the Editor of the Scientific American:

I wish to remark upon the cause of a disastrous explosion which occurred in our city on May 5, 1873:

The boiler was a portable one, of about 10 horse power. It was about 10 feet long and of 30 inches diameter. It had 24 three inch flues, and a furnace 3 feet 3 inches x 2 feet 1 inch, with a water bottom. The inside sheets of the furnace were $\frac{5}{16}$ of an inch thick, of an excellent quality of iron. The entire outside firebox and shell were of ¼ inch iron, of a poor lamellar crystalline structure; the quality, however, was no worse than is usually used for the outsides of such boilers. The stay bolts in the furnace, crown sheets, etc., were insufficiently riveted over on the inside, which was the only defect of workmanship which appeared to exist.

But the safety valve was much too small, and the manner of weighting it was bad. The diameter of the opening was but $1\frac{6}{16}$ inches, and the valve was held down by a lever and spring balance, the nut of which I found screwed down 3½ inches upon the stem. It is well known, among railroad men at least, how the steam pressure used to run up in the boilers with the old style of spring balance; the only way to reduce such excess was to slack off the thumb nuts. It is easy to imagine that a boiler, short of water, the engine standing still, will rapidly get up steam; and there was an immense fire in the large furnace of this boiler, of tar barrel staves, left to itself and to the mercy of a safety valve as described above. Of course, the engineer is not to blame, as (being green) he knew no better; but what can I say of his employers? The cause of explosion was an excessive pressure of steam, from over firing and the center of the crown sheet being dry and overheated. The effect of these combined causes was a reversal of the arch of crown sheet, which was then the cause of the destruction of the other portions of the boiler.

It is seldom that the causes of explosions are as visible as they were in this case, and in one which occurred at the Geddes rolling mill some time since. OPERA MUNDI.

Diving Bells.

To the Editor of the Scientific American:

It has occurred to me, while reading in your current volume an account of a submarine observatory and photographic gallery, invented by M. D. Toselli, that, instead of the top chamber for containing respirable air (which the operator will consume in a short time), he should take with him the materials used for evolving oxygen gas; he could then stay under water for a longer time.

Oxygen gas is generally obtained from substances by heat; but if *aqua regia* be poured on black oxide of manganese the gas is evolved without any other aid. QUINTIS.

Philadelphia, Pa.

A NEW PREVENTIVE FOR SLIPPING BELTS.

We doubt if any more prolific source of loss of power in its transmission from motor to work exists than through the medium of slipping belts; nor, as a moment's consideration will show, is there any ordinary mechanical defect more destructive to that system of careful economy which should be the rule in every well regulated workshop. It is of little use to maintain and run a powerful engine, if the very power which represents the cost of so much labor and so much fuel is to be wasted before it can be applied to useful purposes. Suppose, for example, a pulley makes 100 revolutions per minute. Experiments conducted in England in 1863 proved that. when the power is transmitted by belting, there are, out of this number of revolutions, two slipped. Clearly, then, but 98 per cent of the power is forwarded to the work; and if there be numerous intermediate gearings, a still proportionally less fraction of the original efficient labor of the engine becomes utilized. In a case of which we were recently informed, fully 8 per cent of the power was thus totally lost. For a 200 horse power engine, 8 per cent means 16 horse power thrown away, or at a low estimate 32 pounds of fuel per hour burned without producing any other result than wearing out the belt and heating the pulley.

There are, of course, means for obviating slip to a certain degree. Probably those most commonly employed are the reprehensible habit of covering the periphery of the wheel with oil, resin, or adhesive matter, or of tightening the band, thereby bringing heavy pressure to bear upon the journals, increasing the friction and expediting the wear of the belt. Better than either of these is a plan which has lately come under our notice, which consists in covering the pulley with a flat band of elastic rubber and cloth made about one inch per foot shorter than the circumference, and with its inside face unvulcanized. This is stretched around the wheel and cemented fast. It is plain at once that, by this means, friction between belt and pulley must be materially increased, but to what extent the following results of experiment will best show. The tests made in our presence were conducted on an special apparatus consisting of two 12 inch pulleys on a shaft in bearings so that it could freely revolve. Upon one wheel the inventor (Mr. John W. Sutton, room 2, 95 Liberty street, this city) had placed his cover; the other had a plain smooth face. Over the plain wheel was passed a four inch belt, one end of which was secured to the floor; to the other extremity (the slack side of the band) were hung adjustable weights. Upon the covered pulley a two inch belt was placed, which also carried a weight at one end but at the other was attached to a hand lever. On suspending 29 pounds to the small band, and some 60 pounds to the large one, it was found, on applying a pressure to the lever, that the smooth wheel was caused to slip with great readiness. Without augmenting the weight on the small band, that bearing upon the smooth wheel was increased to 108 pounds, in spite of which the latter was easily and by the same means made to slip. Above this limit, however, the power of the covered wheel did not extend, and on the addition of more weight it also began to yield. The result may therefore be summed up in the fact that the friction of 29 pounds opposing the pressure of a hand lever on a 2 inch belt, aided by the pulley cover, was sufficient to overcome the friction of 108 pounds acting on a four inch belt, opposing a solid support, but applied to a smooth though otherwise similar pulley.

A second test was made with a smaller apparatus having an 8 inch pulley and a 1 inch belt. The result was gained by the aid of a lever and steel yard suitably arranged. With the pulley smooth the scale marked 3½ pounds, when the belt slipped freely. When, however, the cover was applied to the surface of the same wheel, the pointer indicated 19 pounds, or some 5 times the resistance. It would seem from the above that the claim of the inventor, that his device will transmit 100 per cent more power than the smooth pulley and consequently do twice the work before the belt will slip, is well founded, as such estimates are manifestly much below those obtained by actual trial.

So simple and effective an invention as this is worthy of the attention of machinists generally. It is readily and quickly applied, and in point of expense is inconsiderable in comparison with the economy which its employment must produce. We are informed that it is durable. The examples now in use for fourteen months exhibit no appreciable sign of wear.

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TANITE EMERY GRINDER WITH ADJUSTABLE TABLE.

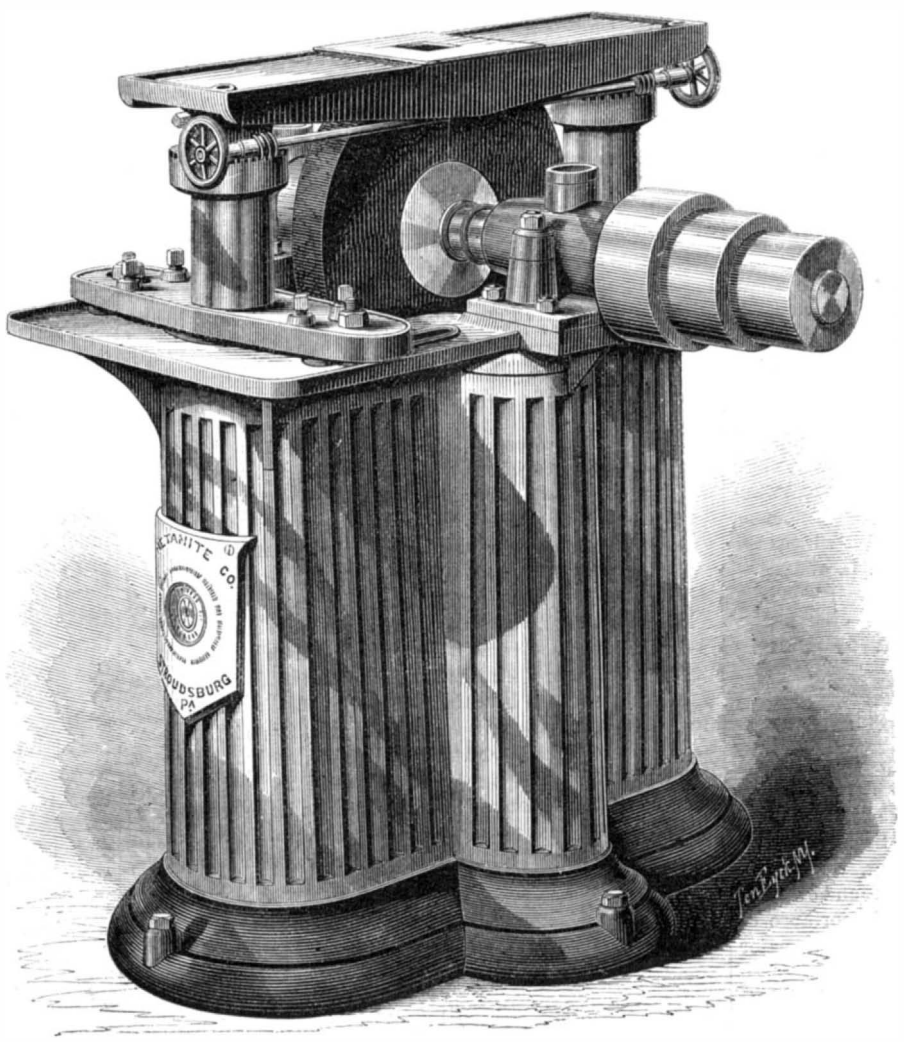
The accompanying illustration shows a machine designed to run emery wheels for accurate facing or grinding on surfaces. The principal difficulty encountered in performing this operation has been to so hold the work that the metal being ground should press evenly at all parts cut by the wheel, and yet not bear so heavily as to generate too much frictional heat, which frequently causes injury to both the metal and the emery wheel. The Tanite emery wheel here shown is 16 inches in diameter by 3 inches face, and is run on a steel arbor 2 inches in diameter. The journal boxes are each 9 inches long. The table is 29 inches by 8 inches, and is faced with an accurately ground steel plate, in which is an opening over the top of the emery wheel. If so desired, this plate can be of sufficient size to cover the whole surface of the table. The adjustment is effected by turning the hand wheels, which are on the same rod, and are shown at either end of the table. Motion is transmitted through the worm and crown gear close under the table to two inch and a half screws, working in the two vertical sleeves similarly located. This adjustment is very accurate and, if desired, very slight, even to the $\frac{1}{300}$ of an inch. The vertical screws are hidden from view by the sleeves, which work on the principle of the tail stock to a lathe. The support through which the sleeve operates is fastened to the frame of the grinder at each end by a bolt and nut, and is leveled and adjusted by four set screws.

It is well known that all makers of solid emery wheels manufacture their products with the same general gradations of coarseness and fineness, dependent on the size of grain emery used. In addition, however, to the varied qualities produced by these differences, the Tanite Company's wheels possess others, dependent on their special processes for tempering the wheels. Thus, if two wheels are made of the same sized emery, and one is for edge and the other is for surface work, they are so varied in temper as to fit each for its special use. This difference in temper is seldom understood by the users of wheels, who, supposing all to be alike, except in point of coarseness, subject all to similar treatment, and thus, through misusing the goods, fail to obtain proper results.

The machine now illustrated is specially designed to prevent this misemployment of wheels tempered for surface operation, which are so constituted that a too heavy or an unequal pressure results in rapid wear of the wheel and small product of work.

The adjustments of this machine are claimed to be such that the least steady and most heavy handed workman cannot fail to bring wheel and metal together in light and even contact. It is unnecessary for us to point out to machinists generally that this use of wide-faced wheels, properly tempered and so mounted that they cannot be recklessly used up or worn out of shape, is an important step toward making solid emery wheels as successful for grinding large flat surfaces truly as they now are for general edging, spruing and rough grinding. The varied uses of this machine are obvious and will readily suggest themselves.

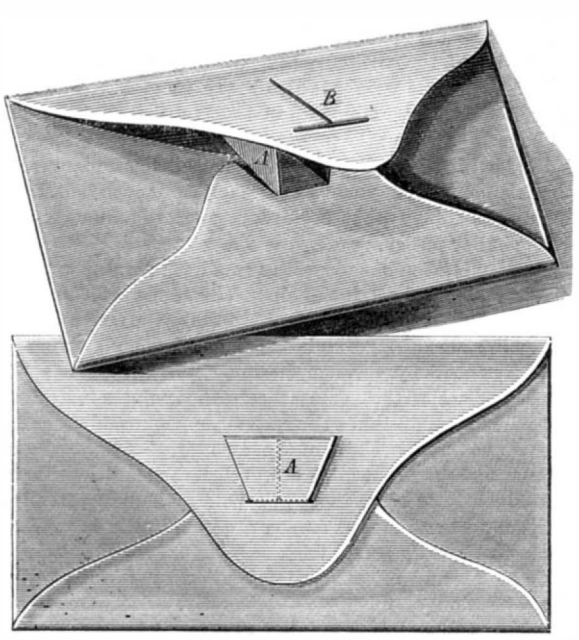
For further information address the Tanite Company, of Stroudsburg, Monroe Co., Pa., as per advertisement on last page.



No. 4 TANITE EMERY GRINDER WITH ADJUSTABLE TABLE.

LOCK ENVELOPE.

There are few who, at some period, have not experienced the annoyance of receiving or sending letters, the envelopes



of which have, through a careless handling or other causes, sprung open in their transit. In the course of a voluminous correspondence, such as is carried by express companies and large business houses, improper sealing of missives is very apt to occur, and through such oversight important inclosures are often defaced or irretrievably lost.

In the invention which we herewith illustrate, this difficulty is guarded against, and the letter securely contained, even if the mucilage fail to adhere, by a very simple locking arrangement of the envelope. On the lower fold of the back of the latter is made a dovetail-shaped slip, A, as shown, and in the upper fold are cut two slits, as shown at B. To lock the envelope, the corners of the slip are bent inwards, as in the upper figure, and the latter is then easily pushed through the opening in the upper fold. The horizontal portion of the cut then admits of the slip being spread out flat, when, its back being gummed and moistened, it adheres to the envelope.

The efficacy of this device is obvious from the fact that, even in case the paste does not stick, it is impossible for the dovetail to come out of the slit unless it be deliberately folded and pushed through. For circulars and other documents generally forwarded unsealed, this envelope is also well suited.

For further information address the inventor, Mr. J. D. McAnulty, No. 127 South 9th (corner 4th) street, Williamsburgh, L. I.

Perfumery and the Sense of Smell.

It may be doubted whether anything is really known regarding the actual composition and nature of the substance of most of the pleasing odors. We know perfectly well, says Mr. James Paton, the bodies which yield odors, and chemists can tell with absolute precision what is their chemical structure; but although they can further tell the conditions essential to the sensation of smell, the subtle essence which gives rise to it appears to be too ethereal for human detection or manipulation. A grain of musk will perfume millions of cubic feet of atmospheric air and still it continues apparently a grain of musk. The following minute quantities of different substances spread out on the surface of smell cause a distinct sensation:

Phosphoreted hydrogen, $\frac{1}{3000}$ grain; sulphureted hydrogen $\frac{1}{30000}$ grain; bromine, $\frac{1}{40000}$ grain; oil of resin, $\frac{1}{1300000}$ grain. A still smaller quantity of musk than the last given smells strongly, but the actual measure has not been ascertained.

It is assured that, for the perception of an odor, it is necessary that the body to be smelt must be in a gaseous condition, just as it is required that, before we experience a taste, the substance must be dissolved; and for the sensation of touch, a resisting solid is necessary. Odorous gases are such as are readily and energetically acted on by oxygen, and the presence of oxygen is therefore a necessary condition of smell. Such gases as mix freely without uniting with oxygen—as hydrogen and nitrogen—are inodorous. In order also to experience the sensation of smell it is necessary that the odoriferous particles impinge with some violence upon the surface of the sensitive membrane in the nose which corresponds with the olfactory nerve; therefore, when we wish to experience a strong sensation of smell we sniff strongly, and when a disagreeable odor is to be avoided, we hold our breath, and breathe out when we think we are beyond its influence

Manufacture of Carmine.

This is one of Nature's most gorgeous products in the way of color. That lovely, rich shade of red is solely produced from a decoction of the cochineal bug. Wherever the cactus is indigenous, there this little insect is to be found in myriads, feeding on the plant and imbuing its own blood with the glorious red of the flower. Only the females are used for making carmine; but as there are 300 females to one male, there is not much difficulty in picking out that solitary representative of the ruling sex. Woman's rights have full sway in this particular branch of the insect kingdom. The excellence and purity of this color and vermilions—in fact, of all colors—depend on careful and thorough washing in water. Some vermilions are washed as often as sixteen times before the pigment is sent to the drying rooms. In the manufacture of some of the finer colors, too, milk, eggs, or cheese are used with the chemicals as purifiers. The most surprising thing, says a correspondent of the New York *Times*, describing the Plymouth Color Works at Bergen Point, N. J., is to see the water that is drawn off from the huge tanks of color after it has been well stirred and washed. The tanks being lined with fine muslin, not a particle of color escapes, and the water is pure and clear as drinking water. Lakes of different shades are made from carmine combined with a chemical body, which cheapens the color and makes it of any desired hue. Rose pink and cheap lakes are made from a decoction of a red wood which is found in Brazil. Pure carmine is very expensive, costing in bulk at wholesale $8 a pound.

IMPROVED SPINDLE STEP.

The object of this invention is an improved construction of the steps of mill spindles or other vertical shafts, whereby they are made adjustable to compensate for the wear of the bearing surfaces.

The illustrations show, Fig. 1, a perspective view with a portion broken away, and Fig. 2, a vertical cross section. In the base, A, of iron is formed a recess, the walls of which are screw-threaded to receive a correspondingly formed guide or bearing, B. The latter is constructed with an inverted conical opening to inclose the toe of the spindle, C, the end of which extends through and rests upon the upper of two or more hardened steel disks, D, placed in a suitable cavity at the bottom of the recess. The top of the guide forms a collar, E, which is beveled off around the interior to receive oil for lubricating the spindle. The passages, F, in the base also serve to conduct lubricating material to the spindle toe. G is a lock nut screwed upon the guide between the collar and the base. In the engravings, Fig. 1 shows the guide let into the base to the full extent and locked in position by the nut, G, screwed down to bear upon the upper surface of the latter. As the guide becomes worn by the rotation of the spindle, it is unscrewed and moved up, Fig 2, to the requisite hight to fit the toe snugly and prevent the spindle from vibrating or running out of true; thus, in short, compensating for the wear. The nut, G, is then again screwed down to lock the parts in place. By using a number of disks, D, one, two, or more can be removed as the spindle drops down, thus adjusting the step regularly to supply the deficiency by wear. The invention appears durable and simple

Fig. 1

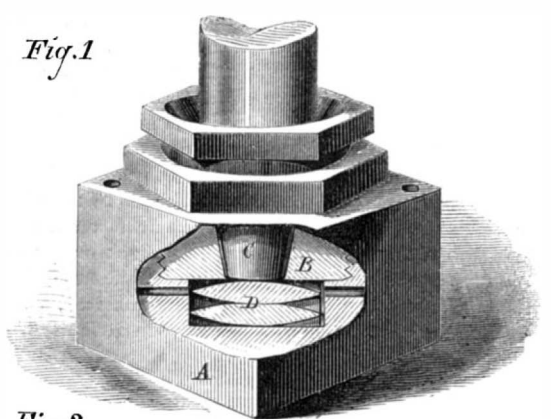
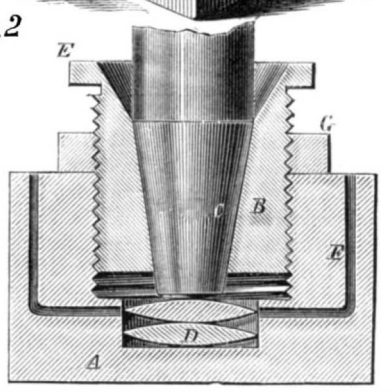


Fig. 2



Its efficiency will doubtless be proved by actual employment.

Patented April 1, 1873. For further information address the inventor, J. J. Henry, 236 Lexington st., Baltimore, Md.

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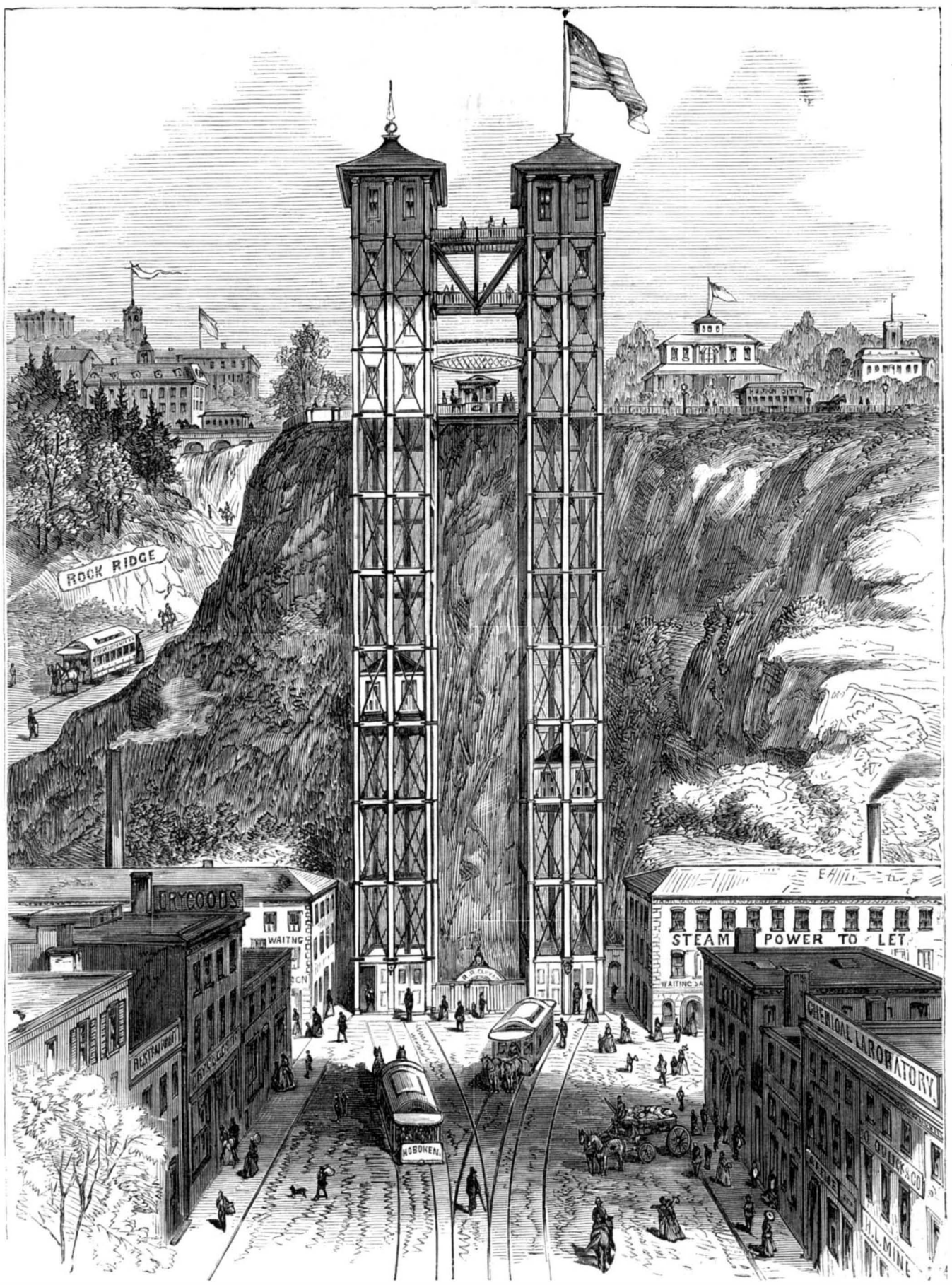
CAR AND PASSENGER ELEVATOR.

Our illustration represents a proposed method of securing rapid transit between Hoboken (opposite New York city, in New Jersey, east of the Palisades), and Jersey City Hights, North Bergen, Bonnville, and other localities in Hudson county, in that State. The topography of the route is very irregular, necessitating circuitous roads to avoid high eminences, and rendering a direct path by ordinary means impracticable. The present system is now being carried out by the Hudson County Elevating Company, an association incorporated "to erect elevators, driven by steam or other power, at the base of Jersey City Hights or Palisades, at such points as said Company may select, for the easy elevation of street cars, teams, passengers, etc."

The mechanism of the invention was devised by Edwin L. Brady, civil engineer, of Jersey City. The lifting cars will be constructed entirely of iron, with strong angle iron frameworks, all centering upon a huge ring bolt at the top of the car, to which wire cables are attached. To the latter steam power is applied, which it is estimated will accomplish the lift of 200 feet in about one and a quarter minutes. Safety idlers, moving on independent cylinders, are arranged, and a system of check pawls, attached to each of the eight iron columns, are also provided to guard against any danger of accident. Each column will be twenty-four inches in diamter and, with the exception of the two upper sections which are of wood, constructed entirely of iron. They will be securely adjusted by iron truss braces, and strongly keyed to the rocky sides of the cliff.

At the base of the elevator two large buildings are to be erected, in order to afford means of utilizing the surplus steam power. Ample room will be provided for elevating cars and teams and for the transportation of one hundred foot passengers at once. Galleries will be added to the upper portions of the structure, from which a fine view of the surroundings will be obtained. The work now in progress, it is estimated, will be completed by the first of July next.

Should the plan be found feasible for elevating horse cars, teams, and passengers, it is not unlikely that the railroads extending westward may adopt a similar plan for taking their passengers over the hill instead of through Bergen tunnel, which the Erie, and the Delaware, Lackawanna, and Western railroads now have to traverse.



THE CAR AND PASSENGER ELEVATOR, IN JERSEY CITY.

The Planet between Mercury and the Sun.

At a recent meeting of the Manchester Literary and Philosophical Society, Mr. Joseph Sidebotham, F.R.A.S., said: "As there is again some speculation as to the existence of an intra-mercurial planet, and every little fact bearing on the subject may be of value, I have referred to my diary, and find that on Monday, March 12, 1849, our late member, Mr. G. C. Lowe, and I saw a small circular black spot cross a portion of the sun's disk. We were trying the mounting and adjustment of a seven inch reflector we had been making, and used an ink box between the eye piece and the plane speculum. At first we thought this small black spot was upon the eye piece, but soon found it was on the sun's disk, and we watched its progress across the disk for nearly half an hour. The only note in my diary is the fact of the spot being seen; no time is mentioned; but if I remember rightly, it was about 4 o'clock in the afternoon."

Nickel Plated Speculum.

In a letter which Mr. Sidebotham had received from Professor Hamilton L. Smith, of Hobart College, Geneva, N. Y., the writer suggests the use of iron or bell metal specula coated with nickel, for reflecting telescopes. He says: "I ground and prepared a bell metal speculum, which I coated with nickel, and this, when polished, proved to be more reflective (at least I thought so) than speculum metal. The two objects which I sought were, first, to have a polished surface unattackable by sulphuretted hydrogen (this, for example, is not injured by packing with lucifer matches), and, secondly, for large specula, doing the most of the work by the turning tool and lathe. I really think a large, say three feet, mirror, coated with nickel, but cast of iron, and finished mostly in the lathe, while it would not cost the tenth of a similar sized one of speculum metal, would be almost equal to silvered of glass the same size, and vastly more enduring as to polish."

Iguana or Tree Lizard.

The largest specimen of the iguana or tree lizard of South America that has ever been seen in this country was lately received, in good health, at the Army Medical Museum, Washington. The reptile is almost entirely black, or a dark chocolate brown, is thirty inches long, and on the top of the head has a large round protuberance like a swelling, while on each side of the head, near its base, appears a similar immense ball. The eye is prominent, very bright, and is of a bright hazel or yellowish color, leaving the pupil brown. The fore feet, or hands, have the fingers formed very like the human hand, while the thumb or toe, corresponding to the human thumb, is quite short and is large and round. The joints are protected and covered by a formation resembling armor, and the body and tail seem at first glance to be free from scales, though a closer examination shows the scales to be small and smooth. The reptile has not yet been identified as belonging to any species heretofore known, as it does not appear in Cuvier. It is the intention of Dr Woodward to kill it and prepare the skeleton for mounting; but it has been suggested that a cast be taken, before killing, for exhibition in the collection of the Smithsonian Institute.

The Salt Deposits of Western Ontario, Canada.

The superficial area of the Ontario salt deposits is comparatively small, and the whole salt bearing district may be included within the counties of Huron and Bruce. Mr. John Gibson, B. A., in a paper in the *American Journal of Science and Arts*, gives some interesting facts regarding the principal wells, eight of which he has recently examined. The Ainleyville well was sunk 1,244 feet, and then abandoned. The position of the boring marked the north-eastern margin of the ancient salt lake, and the geological horizon of the salt was passed without the least evidence of its occurrence. The Kincardine well reached a depth of 957 feet, and the Goderich company's boring struck the salt rock at exactly 1,000 feet below the surface. From this depth was obtained, by pumping, a saturated brine from which large quantities of salt continue to be manufactured. The salt bearing stratum lies immediately at the base of the Onondaga formation, and is at once recognized by the presence of saliferous and gypsiferous magnesian marls, lying as a general rule above the salt bed. The Dominion well was sunk 1,113 feet, and the brine pumped up constantly marks 87° salinometer, with a temperature of 62° Fah. Hawley well extends 967 feet, and the Clinton well 1,136 feet. From the Stapleton well, 1,220 feet in depth, brines of great purity are yielded. It may be mentioned that the prevalence of vast quantities of gypsum and salt in a mixed state naturally suggests the utility of a shaft by which not only could pure rock salt be obtained, but also the combined gypsum and salt for agricultural purposes. The drilling done in Coleman and Gowinlock's well is said to be unprecedented, both for speed and absence of mishaps. Actual boring commenced on the 10th of March, 1870, and the salt-bearing stratum was reached on the eve of the 22d of the same month at a depth of 1,035 feet. After passing through 100 feet of pure rock salt, without the least evidence of change, the boring was abandoned.

In no other portion of the American continent has there been discovered a deposit of salt so magnificently great. The supply is practically illimitable and may favorably compare with the production of the salt mines of Droitwich, in central England, or with that of the solid salt hills of Cordova.

THE residues from molasses are used in France for the manufacture of carbonate of potash.

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Anæsthetics.

This is a term derived from the Greek word *anæsthesis*, meaning those agents which, like nitrous oxide, ether, and chloroform, produce insensibility to pain.

That there are two sides to every question is very forcibly illustrated in the attempt to place the honors of the discovery of anæsthetics where they rightfully belong. In a recent scientific lecture, on this subject, delivered here by Dr. Sims, he awards the credit of first using anæsthetics, for the relief of human sufferers under disease or surgery, to Dr. Wells, of Hartford, Conn. The *Evening Post*, of this city, in commenting upon the statements of Dr. Sims, says:

"The difficulty with Dr. Wells' claim is that, though he experimented with anæthesias, with nitrous oxide gas, perhaps with ether, he never established their use. The real question at issue is, not who discovered the possibility of producing insensibility under surgical operations, but who established the possibility with a known agent and brought it into practical use.

Sir Humphrey Davy, early in this century, relieved pain by the use of nitrous oxide gas, and suggested that it might "be used with advantage during surgical operations." Pliny, and some Greek physicians after him, recommended the use of certain herbs, especially of mandragora, for their soporific power; and, said one of them: "Medical men use it for those who are to be cut or cauterized." The Chinese, who preceded the western world in so many discoveries, are supposed to have used anæthesia at a remote age. In the middle ages, other agents were used for the same purpose. In 1823 Mr. Hickman, a surgeon of London, and in 1832 Dauriol, a French physician, used gas, and, they asserted, successfully. Other French physicians, recommended and performed operations with some success when patients were under the influence of alcoholic intoxication, and later mesmerism was suggested and tried in some cases. Thus for many centuries, alleviation from pain has been sought for; discoveries have been made, and perhaps some limited practical application of them maintained; but the man had not yet appeared who had made it clear to surgeons and to the world at large that any of the known agents were so safe and so available that they could be brought into common use.

Neither Jackson, Morton nor Wells, then, was the discoverer of anæsthetic agents, any more than Fulton discovered steam, or Morse, electricity. The question is: Which of them first successfully applied such an agent and established its general use? Unquestionably Wells tried, as others, scattered along through the centuries, had tried before and failed. He pulled a few teeth, but either he wanted the energy or the confidence to persevere; Jackson understood the properties of ether, gave some instructions to Morton; perhaps he even recommended ether to Morton as the agent he was in search of, but he did not establish its use; there is even evidence that he doubted if it could be used without danger, to produce insensibility. But it was Morton who had the energy and perseverance to insist upon trial after trial till the virtue of the remedy was established to the satisfaction of the world at large. It is the first step that costs and counts, and that step was Morton's.

In reply to this, Dr. G. Q. Colton very emphatically upsets the theory of the Wells abandonment. "We have," he says, "the sworn testimony, of about forty of the most respectable citizens of Hartford, that during the years of 1845 and 1846 Wells extracted teeth for them without pain, using the gas as the anæsthetic. He was in constant use of the gas for about eighteen months, when his health gave way, and he went to Europe. Even in Europe he did not abandon his discovery, for he presented his claims to the Academy of Sciences in Paris, and that institution, in recognition of the services, conferred on him the title of M. D.

As soon as Wells returned to this country he resumed the use of the gas, and continued it until his death, which occurred on the 24th of January, 1858.

But he met the most determined and bitter opposition from all quarters. It was at that time too much to believe that the inhalation of so little gas or vapor would destroy the pain of a surgical operation! Dr. Wells did all that a man could do, while he lived, to prove to the world the value of his discovery. Should he be deprived of the honor of the discovery because the public were incredulous and repudiated his claims?

Wells died before the merits of the gas were generally recognized. After his death Dr. Morton set up the claim that nitrous oxide was not an anæsthetic, and therefore that Wells had discovered nothing. No one had used the gas to produce anæsthesia save Wells, and Morton was enabled to gain a general assent to the position he took, namely, that, nitrous oxide not being an anæsthetic, therefore he, Morton, was the discoverer of anæsthesia! If at that time and during the lifetime of Mr. Wells the gas had proved to be what it really is, and what I have demonstrated it to be, the best and safest anæsthetic known, we never should have heard of Morton as the discoverer of anæsthesia.

When I revived the use of the gas in 1863, I had this general incredulity respecting its powers to contend with. I was met on all sides by the assertion that Wells had tried the gas and it had proved a failure. I expended eight thousand dollars the first year in advertising, advocating, and defending it; and in all this time did not realize a dollar of profit from my business. Is it any wonder that poor Wells, who had no money to spend, should encounter opposition and discouragement in its first introduction?

It should be remembered that Wells' first experiment—for which I gave him the gas—was on the 11th of December, 1844, and that the first experiment by Morton was on the 30th of September, 1846; also that Morton was stimulated to this experiment by information derived from Wells and newspaper notices of Wells' operations.

In view of all these facts," says Dr. Colton," how can any one hesitate to award the honor of the discovery of anæsthesia to Dr. Wells?"

The A B C Process.---London Filth transformed into Shining Gold.

The process of precipitating by sulphate of alumina the valuable constituents of sewage, and utilizing at the same time the purifying power of charcoal and clay, is that to which, says the *Journal of Science*, we decidedly give the preference, as by this means the water is practically purified fit to be discharged into a running stream, and the deposit is retained in a form entirely inoffensive and capable of being turned into a dry and portable manure. This process has been before the world for some years as the A B C process, being derived from the initial letters of the principal constituents of the precipitant: alum, blood, clay and charcoal.

In contact with sewage—a slightly alkaline liquid charged with nitrogenous organic matter—the alumina is separated in flocks, and, by virtue of its remarkable affinity for dissolved organic matter, each particle seizes hold of, and drags down with it, a corresponding particle of nitrogenous impurity. The blood here comes into play; this is essentially a liquid highly charged with albumen; albumen, is instantly coagulated in the presence of alum; and in the same way as this ready coagulability of albumen is utilized in fining wine and coffee, so it is made use of in this process by joining with the alumina in its precipitation, uniting it in a network of fibers, and giving it, as it were, arms wherewith to seize upon and drag out of solution still more putrescible constituents.

But the precipitated hydrate of alumina is light in character; and although it would ultimately settle, leaving a clear liquid above it, the slightest agitation causes it to float up, and thus renders it difficult, on the large scale, to drain off the mud. Here the action of the clay is apparent. This substance has a curious physical property; when finely ground up with water, it forms a creamy emulsion, which takes many days to settle. But when this creamy liquid meets with sulphate of alumina, the clay coagulates like albumen, and settles down in heavy granular flakes. Now in the A B C process these three precipitations—that of the alumina, that of the albumen, and that of the clay—take place simultaneously, and in each other's presence; they become closely locked together in a triple alliance; the heavy character of the clay particles gives density to the mass, and causes it to settle rapidly, and remain in a compact form at the bottom of the tank.

There still remains the probability, if not the certainty, of foul gases being present, while the water, though clear, may nevertheless be colored. These residual impurities are attacked by the charcoal; the powerful affinity of animal charcoal for organic coloring matter corrects the one evil, while the well known absorptive action exerted by vegetable charcoal on the gaseous products of putrefaction corrects the other.

The method of applying the ingredients is extremely simple. The clay and charcoal are incorporated in a grinding mill, with the aid of sufficient water to form a thin paste. This paste flows into a tank, and is constantly agitated until it is required to be mixed with the sewage. By the side of the mixing room is a smaller room, through which passes a channel or trough. At one end of this channel there rushes in the London sewage, and with it an unmistakable odor. The B C mixture, or thin water paste of clay and charcoal, is admitted to the trough by a pipe from the store tank; the sewage in its passage past this pipe carries with it the mixture, and the two, after well mixing, proceed on their way past a second pipe connected with a tank containing a supply of sulphate of alumina dissolved in water. All that is now requisite is to allow the sewage, B C mixture, and alum to flow in inodorous company to the settling tanks. The channel leading to the tanks has its course interrupted by numerous ledges, which serve to cause the more perfect intermixture of the sewage and the disinfectants. The first tank in which the sludge is allowed to settle contains the principal portion of the precipitate. The clear water is allowed to flow off continuously from the first tank into a second tank; and the remainder of the mud is deposited in this and in the other tanks into which it flows. From the last tank the water is conducted to the river, appearing as a clear, inodorous and tasteless effluent. When sufficient sludge has been collected in the first tank, the treated sewage is shut off from this and permitted to flow into another tank, which then forms the first of the series. As much of the water as possible is then run off from the mud, and the latter is drawn into the acidifying tanks, where a small quantity of sulphuric acid is added to prevent the loss of any ammonia. From the acidifying tanks the semi-dry mud is pumped into the drying presses, whence it issues in a cake. This semi-solid mud is then further dried by a most ingenious application of heat in revolving iron cylinders. The wet mud is passed in at one end, and dry manure, in the form of an inodorous and inoffensive powder, falls from the other end, at the rate of 5 tuns in ten hours, at the expenditure of a few hundredweights of coal.

If space enough be available, the mud may be simply pumped, from the bottom of the settling tanks, into large open air stanks, where it dries under the influence of the sun and air. Not the slightest offensive odor is apparent during any stage of this drying.

The dry mud in powder, forming excellent manure, is removed from the sheds, and packed into bags for transport.

Crossness is situated on a projecting part of the southern shore of the Thames, between the Plumstead and Erith marshes, and is the southern outfall of the London drainage. The quantity of sewage now daily discharging at Crossness is 50,000,000 gallons. Large as this quantity may appear, the enormous engines employed in pumping the sewage are fully equal to the task, for they are capable of lifting 280 tuns in a minute, or nearly double the average flow. The transformation of such a mighty mass of filth into heaps of shining gold is a feat worthy of the days of the alchemist, or rather of the days of modern chemistry. Of this quantity of sewage, the works of the Native Guano Company are capable of dealing in the twenty-four hours with 500,000 gallons, drawn from the cross-cut or culvert through which the sewage runs into the principal reservoir. This quantity amounts to 1 per cent of the whole delivery. Thither the sewage flows into the sump of a pump worked by a 15 horse power steam engine, whence it flows into contact with the A B C constituents as we have described.

During an official trial, lately completed, extending over eighty days, there were used 80 tuns of dry A B C materials, while the "native guano" obtained amounted, in the dry state, to 131 tuns, showing an increase of more than 63 per cent. The amount of sewage treated during this time was 11,672,000 gallons. Therefore 1 tun of dry native guano was obtained from 89,100 gallons of the Crossness sewage.

With scarcely an exception, the farmers are unanimous in their approval of "native guano:" many of them, shrewd, intelligent men, well acquainted with the various artificial manures in the market, have tried "native guano" with intelligence on different fields against other manures, and were assured that, putting equal values per acre, it was superior to most manures in the market.

SANITARY NOTES---MILK AND ITS ADULTERATIONS.

It is proposed in this paper, drawn from the report of Dr. A. H. Nichols and Professor J. F. Babcock, to consider briefly the various methods which are resorted to for the purpose of adulterating milk, and the means which have been afforded to us by chemistry for their detection.

THE COMPOSITION OF MILK.

Genuine milk is composed of water holding, either in suspension or solution, fat globules, casein or cheesy matter, sugar, and various mineral matters or salts. It is a physiological fact that the quantity and quality of milk may vary, not only in different cows, but in the same cow, this variation depending upon: 1. The breed of the cow from which it is obtained. Alderneys, for example, give milk containing a large proportion of cream, and hence forming a very nutritious food for infants; while Durhams produce a fluid richer in casein and, on this account, especially adapted to the manufacture of cheese. 2. On the number of calves born, and time since calving. Less milk is given with the first calf than with the subsequent ones; and for a week or ten days after every birth a yellow, thick, stringy substance, called colostrum, is secreted, which is unfit for use. 3. On the character of the food furnished to the animal. When fed principally on carrots, there is a slight diminution in the amount of casein and butter and an increase in the quantity of sugar. This is still more marked when beet root is made the chief article of diet. If the food consists of the refuse of distilleries, the animals often become diseased, and the milk given is manifestly unfit for consumption. The yield of milk is most abundant in spring. In dry seasons the quantity secreted is less, but the quality is richer. An unpleasant taste and odor is said to be imparted to milk by an exclusive diet of turnips or oil cake, and the same is also the case when the cows feed upon wild garlic or other weeds and leaves of plants where the pasturage is bad. 4. On the cleanliness and ventilation of stables, and care bestowed upon the animals. It often happens that milk, of high specific gravity and yielding a large per cent of cream, becomes so thoroughly impregnated with the vitiated air of the stable as to be decidedly repulsive to the taste. 5. On the time of milking. The afternoon milk is richer, on the average, by one fourth than that obtained in the morning, and the last portion of a milking is much the richest and is often reserved for cream.

METHODS OF EXAMINATION.

The hydrometer alone affords an imperfect test of the richness of a specimen, for many reasons, prominent among which is that the specific gravity of impoverished milk may be fraudulently lowered or raised by the admixture of various ingredients, principally water and salt. The ordinary specific gravity of milk at 50° Fah. ranges between 1·029 and 1·037, and it is no secret to milkmen that this specific gravity is not much changed if four per cent of water be added for every one per cent of cream abstracted. The lactometer is simply a long tube graduated into a hundred parts, and intended to indicate the percentage of cream which has spontaneously separated from the milk and risen to the surface within a given time. This quantity generally measures from 8 to 20 per cent, and, in certain breeds of cows, may amount to even 50 per cent. The instrument furnishes no knowledge of other constituents, such as casein and sugar. The lactoscope determines the richness of milk by measuring its opacity, on the principle that, while the fat globules are opaque, the liquid in which they float is nearly transparent. It is considered to present no material advantage over the lactometer. The microscope enables the eye to estimate the number of fat globules a specimen contains, as well as abnormal constituents, infusoria or fungi which may be present.

ADULTERATING SUBSTANCES AND HOW THEY ARE DETECTED.

These are principally water, flour or starch, gum arabic or

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dextrin, cerebral matter, chalk or whiting, turmeric or annatto, gum tragacanth, carbonate of magnesia, arrowroot, sugar, emulsions of almonds or hempseed, carbonate of soda, eggs and salt. We shall consider them in their order.

Water lessens the specific gravity, and may be detected by measuring the density of either the milk, the skimmed milk or the serum. If a few drops of acetic acid be added to the milk, the fatty matter and casein will be coagulated, and may be removed, leaving the serum. The effect upon this substance by the addition of water is shown by the following:

Serum containing percentages of water.	Specific gravity.
Pure serum	1·029
Water 10 per cent	1·025
20 "	1·022
30 "	1·020
40 "	1·017
50 "	1·014

The quantity of water may also be estimated indirectly by determining quantitatively the amount of the solid constituents or of the milk sugar present.

Flour or starch is easily recognized by adding a few drops of the tincture of iodine to the whey. If this produces the characteristic blue color, it indicates that some amylaceous substance has been added. Starch can also be found by the microscope.

Gum arabic or dextrin is detected by the action of a small quantity of alcohol upon the whey. A dull abundant white precipitate falls, which may be proved to be gum by its properties, and which differs essentially from the light bluish or diaphanous flakes which alcohol produces in pure milk.

Cerebral matter is usually some villanous mixture of the brains of sheep, employed to counteract the blue tinge of impoverished milk. It is rarely used; and if present, generally sinks to the bottom of the vessel. It may be made out by the microscope.

Chalk or whiting is sometimes employed to neutralize the acidity of soured milk. Chalk is insoluble in milk, and hence will form a sediment, the character of which may be detected by the effervescence caused by a drop of acid.

Turmeric or annatto is used to give a rich cream color. Evaporate a portion of the sample to about one eighth its original bulk, and add a small quantity of caustic potash. If the yellow color becomes brownish, turmeric is present; if bright red, annatto.

Gum tragacanth, carbonate of magnesia and arrowroot add consistency and counteract the blue color of the milk. To detect the former, let the fluid stand for some hours and observe if any gelatinous deposit is formed. If so, wash it with water and test with a few drops of the tincture of iodine, when a blue color will be produced, due to the starch contained in the tragacanth. Arrowroot is detected by means of the microscope, by which instrument the round particles of carbonate of magnesia can also be made out. The latter will be found to disappear upon the addition of a drop of acid.

Sugar, in the form of caramel or brown sugar, is used to add to the color and develop the flavor of impoverished milk. Its presence is ascertained by mixing a little yeast with the serum of the sample and exposing the mixture to a temperature of between 70° and 80 Fah. An abundant and rapid disengagement of gas will take place in the course of two or three hours, forming a sure sign, as pure milk cannot ferment in so short a time.

Emulsions of almonds or hempseed are inexpensive substances, and impart an unpleasant flavor to the milk. The addition of a few drops of amygdaline to an ounce of milk containing milk of almonds will cause a development of the odor of bitter almonds.

Carbonate of soda is added to prevent milk from quickly turning sour. When this substance is present, there is a slight increase in the quantity of the cinerated ash, which will be found to effervesce upon the addition of an acid.

Eggs, the admixture of which is one of the most harmless adulterations, are recognized by diaphanous clots formed in boiling the milk. When present in small quantity, the serum of the milk must be boiled, and the flocculi formed compared with the effect of boiling upon serum known to be pure.

Salt is understood to be used quite extensively to increase the specific gravity and develop the flavor of the milk. Its presence cannot be detected by the ordinary observer, but is made manifest to the chemist by the weight and taste of the ash.

ADULTERATION IN LARGE CITIES.

The report from which we draw our facts states that in large cities adulteration of milk is carried to an extent, the fearful nature of which is best evidenced by the mortality among children, of which it forms the principal nourishment. In 1868, the last year of which the records were published, 487 deaths of cholera infantum occurred in Boston, while, in an equal population outside the city, but 100 took place. The cause is attributed to the impure milk, which the country children were not obliged to live upon.

It is stated that, in crowded localities, adulteration is the rule, and the fact is admitted by milkmen generally. It is estimated that the daily supply of milk for the city of Boston, for the year ending March, 1872, was 24,009 gallons, which, for the entire year, would amount to 8,763,285 gallons, the cost of which, to consumers, may be reckoned at $2,979.517. If we assume the average amount of water, fraudulently added, to be but twelve per cent, and this is putting it at a low figure, the amount expended by the citizens during this year for water, apart from the legitimate water rates, amounted to the sum of $357,542.

To indicate more accurately the full amount of the fraudulent gains in this trade, there should be added to this sum the value of the cream poured off from the top of the cans, and sold by the milkmen at a price varying from twenty-five to fifty cents a quart.

Ship Canal in Scotland.

The Caledonian Canal, which, with Loch Ness and other lakes, cuts across Scotland from northeast to southwest, for a distance of sixty miles, between Inverness and Fort William, affords easy passage to ships drawing not more than eighteen feet. The necessity for such a canal is not very great. It serves only to avoid the somewhat dangerous voyage around the northern extremity of the country. But what seems an unwise policy diminishes its usefulness to the smallest possible degree. The tolls are so high that commerce avoids it almost entirely. Steamers, which combine their own motive power with good passenger accommodation, monopolize the usefulness of the canal and pay tolls sufficient to defray the labor of working the locks. Maintaining the canal is thus a large government charge for a very small result. A small toll would serve the country and the interest of the government to greater advantage.

A NEW DIETETIC.—Dr. Goodman, writing to the *British Medical Journal*, says that artificial fibrin is an admirable dietetic substance, being unparalleled for lightness and digestibility, and a great delicacy besides. It is obtained by exposing albuminous material to the action of cold water for a time, the hen's egg, from its great abundance, being the most suitable source of the albumen. When the contents of an egg are immersed in cold water for twelve hours or thereabouts, they undergo a chemico-molecular change, becoming solid and insoluble; a change indicated by the opaque and snowy whiteness of the white. The action of heat to the boiling point is now brought into the process, and the fibrin is then ready for use. In cases of deficient nutrition and rejection of food, Dr. Goodman says this artificial fibrin is of the greatest service, as the weakest stomach is able to retain it, and its use appears to promote the appetite for food.

A COLOSSAL BEER CASK.—The great Hungarian cask, which is capable of containing 2,000 eimers (or 25,000 gallons) of beer and which has been sent for show to the great exhibition at Vienna, is made entirely of wood grown in Hungary, and is said to be a perfect marvel in workmanship.

PROGRESS OF THE HOOSAC TUNNEL IN MAY, 1873.—Headings advanced from east end westward, 155 feet; from west end eastward, 120 feet. Advance during May, 275 feet. Total lengths opened to June 1st, 23,367 feet. Rock remaining to be penetrated, 1,664 feet; being 96 feet less than one third of a mile.

J. A. B. says: "I have taken the SCIENTIFIC AMERICAN ever since I commenced to learn my trade, and it is not too much to say that that journal has had a great deal to do with the raising of my salary from $500 a year to $1,700."

Value of Patents,

AND HOW TO OBTAIN THEM.

Practical Hints to Inventors.

PROBABLY no investment of a small sum of money brings a greater return than the expense incurred in obtaining a patent even when the invention is but a small one. Larger inventions are found to pay correspondingly well. The names of Blanchard, Morse, Bigelow, Colt, Ericsson, Howe, McCormick, Hoe, and others, who have amassed immense fortunes from their inventions, are well known. And there are thousands of others who have realized large sums from their patents.

More than FIFTY THOUSAND inventors have availed themselves of the services of MUNN & Co. during the TWENTY-SIX years they have acted as solicitors and Publishers of the SCIENTIFIC AMERICAN. They stand at the head in this class of business; and their large corps of assistants, mostly selected from the ranks of the Patent Office: men capable of rendering the best service to the inventor, from the experience practically obtained while examiners in the Patent Office: enables MUNN & Co. to do everything appertaining to patents BETTER and CHEAPER than any other reliable agency.

HOW TO OBTAIN *Patents*

This is the closing inquiry in nearly every letter, describing some invention which comes to this office. A *positive* answer can only be had by presenting a complete application for a patent to the Commissioner of Patents. An application consists of a Model Drawings, Petition, Oath, and full Specification. Various official rules and formalities must also be observed. The efforts of the inventor to do all this business himself are generally without success. After great perplexity and delay, he is usually glad to seek the aid of persons experienced in patent business, and have all the work done over again. The best plan is to solicit proper advice at the beginning. If the parties consulted are honorable men, the inventor may safely confide his ideas to them; they will advise whether the improvement is probably patentable, and will give him all the directions needful to protect his rights.

How Can I Best Secure My Invention?

This is an inquiry which one inventor naturally asks another, who has had some experience in obtaining patents. His answer generally is as follows, and correct:

Construct a neat model, not over a foot in any dimension—smaller if possible—and send by express, prepaid, addressed to MUNN & Co., 37 Park Row, New York, together with a description of its operation and merits. On receipt thereof, they will examine the invention carefully, and advise you as to its patentability, free of charge. Or, if you have not time, or the means at hand, to construct a model, make as good a pen and ink sketch of the improvement as possible and send by mail. An answer as to the prospect of a patent will be received, usually, by return of mail. It is sometimes best to have a search made at the Patent Office, such a measure often saves the cost of an application for a patent.

Preliminary Examination.

In order to have such search, make out a written description of the invention, in your own words, and a pencil, or pen and ink, sketch. Send these with the fee of $5, by mail, addressed to MUNN & Co., 37 Park Row, and in due time you will receive an acknowledgment thereof, followed by a written report in regard to the patentability of your improvement. This special search is made with great care, among the models and patents at Washington, to ascertain whether the improvement presented is patentable.

Rejected Cases.

Rejected cases, or defective papers, remodeled for parties who have made applications for themselves, or through other agents. Terms moderate. Address MUNN & Co., stating particulars.

To Make an Application for a Patent.

The applicant for a patent should furnish a model of his invention if susceptible of one, although sometimes it may be dispensed with; or, if the invention be a chemical production, he must furnish samples of the ingredients of which his composition consists. These should be securely packed, the inventor's name marked on them, and sent by express, prepaid. Small models, from a distance, can often be sent cheaper by mail. The safest way to remit money is by a draft, or postal order, on New York, payable to the order of MUNN & Co. Persons who live in remote parts of the country can usually purchase drafts from their merchants on their New York correspondents.

Caveats.

Persons desiring to file a caveat can have the papers prepared in the shortest time, by sending a sketch and description of the invention. The Government fee for a caveat is $10. A pamphlet of advice regarding applications for patents and caveats is furnished gratis, on application by mail. Address MUNN & Co., 37 Park Row, New York.

Reissues.

A reissue is granted to the original patentee, his heirs, or the assignees of the entire interest, when, by reason of an insufficient or defective specification, the original patent is invalid, provided the error has arisen from inadvertence, accident, or mistake, without any fraudulent or deceptive intention.

A patentee may, at his option, have in his reissue a separate patent for each distinct part of the invention comprehended in his original application by paying the required fee in each case, and complying with the other requirements of the law, as in original applications. Address MUNN & Co. 37 Park Row, for full particulars.

Design Patents.

Foreign designers and manufacturers, who send goods to this country may secure patents here upon their new patterns, and thus prevent others from fabricating or selling the same goods in this market.

A patent for a design may be granted to any person, whether citizen or alien, for any new and original design for a manufacture, bust, statue, alto relievo, or bas relief; any new and original design for the printing of woolen, silk, cotton, or other fabrics; any new and original impression, ornament, pattern, print, or picture, to be printed, painted, cast, or otherwise placed on or worked into any article of manufacture.

Design patents are equally as important to citizens as to foreigners. For full particulars send for pamphlet to MUNN & Co., 37 Park Row, New York

Foreign Patents.

The population of Great Britain is 31,000,000; of France, 37,000,000; Belgium, 5,000,000; Austria, 36,000,000; Prussia, 40,000,000; and Russia, 70,000,000. Patents may be secured by American citizens in all of these countries. Now is the time, while business is dull at home, to take advantage of these immense foreign fields. Mechanical improvements of all kinds are always in demand in Europe. There will never be a better time than the present to take patents abroad. We have reliable business connections with the principal capitals of Europe. A large share of all the patents secured in foreign countries by Americans are obtained through our Agency. Address MUNN & Co., 37 Park Row, New York. Circulars with full information on foreign patents, furnished free.

Value of Extended Patents.

Did patentees realize the fact that their inventions are likely to be more productive of profit during the seven years of extension than the first full term for which their patents were granted, we think more would avail themselves of the extension privilege. Patents granted prior to 1861 may be extended for seven years, for the benefit of the inventor, or of his heirs in case of the decease of the former, by due application to the Patent Office, ninety days before the termination of the patent. The extended time inures to the benefit of the inventor, the assignees under the first term having no rights under the extension, except by special agreement. The Government fee for an extension is $100, and it is necessary that good professional service be obtained to conduct the business before the Patent Office. Full information as to extensions may be had by addressing MUNN & Co., 37 Park Row.

Trademarks.

Any person or firm domiciled in the United States, or any firm or corporation residing in any foreign country where similar privileges are extended to citizens of the United States, may register their designs and obtain protection. This is very important to manufacturers in this country, and equally so to foreigners. For full particulars address MUNN & Co., 37 Park Row New York.

Canadian Patents.

On the first of September, 1872, the new patent law of Canada went into force, and patents are now granted to citizens of the United States on the same favorable terms as to citizens of the Dominion.

In order to apply for a patent in Canada, the applicant must furnish a model, specification and duplicate drawings, substantially the same as in applying for an American patent.

The patent may be taken out either for five years (government fee $20) or for ten years (government fee $40) or for fifteen years (government fee $60). The five and ten year patents may be extended to the term of fifteen years The formalities for extension are simple and not expensive.

American inventions, even if already patented in this country, can be patented in Canada provided the American patent is not more than one year old.

All persons who desire to take out patents in Canada are requested to communicate with MUNN & Co., 37 Park Row, N. Y., who will give prompt attention to the business and furnish full instruction.

Copies of Patents.

Persons desiring any patent issued from 1836 to November 26, 1867, can be supplied with official copies at a reasonable cost, the price depending upon the extent of drawings and length of specification.

Any patent issued since November 27, 1867, at which time the Patent Office commenced printing the drawings and specifications, may be had by remitting to this office $1.

A copy of the claims of any patent issued since 1836 will be furnished for $1.

When ordering copies, please to remit for the same as above, and state name of patentee, title of invention, and date of patent. Address MUNN & Co., Patent Solicitors, 37 Park Row, New York city.

MUNN & Co. will be happy to see inventors in person, at their office, or to advise them by letter. In all cases, they may expect an *honest opinion*. For such consultations, opinions and advice, *no charge is made*. Write plain do not use pencil, nor pale ink: be brief.

All business committed to our care, and all consultations, are kept *secret and strictly confidential*.

In all matters pertaining to patents, such as conducting interferences, procuring extensions, drawing assignments, examinations into the validity of patents, etc., special care and attention is given. For information, and for pamphlets of instruction and advice

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Recent American and Foreign Patents.

Improved Supplementary Wheels for Car Trucks.

Smith Spelman, Brooklyn, N. Y.—This invention has for its object to diminish the friction and consequent wear of car wheels in passing around curves. The invention consists in applying supplementary wheels to run loose on the axle of the ordinary flanged wheels. It is especially applicable on street railways, a wide flat rail being provided for the supplementary wheels to run on.

Improved Washing Machine.

Clarance L. Rose, Roseville, Ill.—This invention is to furnish a washing machine which turns, rubs, and presses the clothes, thus washing them leanly in a short time, with comparatively small exertion in handling. The nvention consists in the double action of the beater by the motion of the scillating tub, producing rubbing and pressing at the same time, the beater arrying the clothes against the rubber and pressing them against it and he bottom of the tub.

Improved Hay Carrier.

Eugene B. Tanner, Attica, Ohio.—The object of this invention is to furnish to farmers and others a simple apparatus for hoisting, carrying, and depositing rapidly hay bales to the desired place in the barn, saving time and labor thereby. The invention consists of lever and guide pieces, in connection with a pulley having a weighted catch lever for suspending the load till ready to be dropped. Suitable guide strings and pulleys facilitate the rapid action of the conveying apparatus.

Improved Stop Mechanism for Looms.

Thomas Isherwood and William Nuttall, Westerly, R. I.—This invention consists of two or more wires, with devices for presenting them behind the weft thread at the middle of the lathe, or thereabout, after the shuttle passes, to insure the action of the weft fork or feeler for throwing off the shipper lever when the weft is present. It also consists of a novel arrangement of means for presenting the feeler to the weft in a suitable position in advance of the cloth, and then moving it away, so as not to interfere with the beating up of the weft by the reed. The arrangement of the stopping mechanism at the middle of the lay saves the necessity of employing one near each edge of the warp. It often happens in looms carrying several shuttles that the wefts break, so that the ends are long enough to raise the latches, owing to the cutting or overstraining of them in particular places by the boxes in which the shuttles are changed.

Improved Skate.

Wendell Strasser, Taylorsville, Ohio.—This invention relates to an improved construction of skates with a view to rendering them more durable, and their attachment to the feet more convenient, secure, and comfortable, enabling the repair or renewal of the runners to be more easily effected than heretofore. The runners are secured in a groove in an iron which is secured to wooden soled boots or shoes, and said iron is detachable from the wooden sole by a peculiar but simple device. The runner is also readily detached from the iron.

Improved Lock Fastening for Mail Pouches, etc.

Brice X. Blair, Huntingdon, Pa.—This invention relates to modes of conveniently applying locks to pouches, satchels, carpet bags, and analogous articles; and it consists in employing two hinged sliding clamps, and in providing the adjacent end of each with a corresponding eye through both of which the padlock is passed and then locked. It also consists in an apertured plate sliding in a recess on top of a plate to hold firmly the name, address or destination of the owner of the pouch, satchel or carpet bag.

Improved Sewing Machine.

George Webster, Jr., and John Fraser Webster, Hamilton City, Province of Ontario, Canada.—This invention consists in a new mode of applying the feed bar mechanism; in a peculiar relative construction of the shuttle carrier and feed bar to enable the former to raise the latter at every forward motion; and in a very simple and convenient mode of regulating the length of stitch.

Improved Fence.

Austin Orvis, Ellington, Iowa.—The invention relates to that class of fences which are placed across streams liable to be flooded with water at one season of the year and obstructed with ice at another. The invention consists in a jointed post which will enable the panel to stand erect in the grazing season, and to be thrown down with its top up the stream in the season of ice.

Improved Cement.

Dr. John E. Park, Sequin, Texas.—This invention relates to a new hydraulic cement, and to a process of burning the same to develope its highest cementitious qualities. The cement is composed of 1 part lime with 30 to 40 per cent of clay (alumina and silica), and 5 to 10 of fine sand (silex), and 5 per cent of soda (carbonate, muriate or caustic), or potash. The principal feature of the process is determining the degree of calcination by means of the color of the material at various stages of the burning; and without the exact degree of calcination, thus determined, the cement will not be of the required quality.

Improved Steam Engine Valve.

Alexander Baumau, London, England.—This invention consists in cutting off the steam from the main cylinder before its piston has reached its throw by detached leading valves, one at each end of the main cylinder and an intermediate one, all moved by the pressure of the steam that fills the main cylinder at or near the completion of each stroke. The piston valves cut off the exhaust of the main cylinder before the end of each stroke, thereby orming therein a steam cushion which checks the momentum of the main piston and receives it with a yielding resistance like a spring, thus making high speeds much safer. It is also economical, because the steam cushion stores up power which is exerted in the reaction to send the piston back.

Clevis Bar, Hook, Whiffletree, and Whiffletree Staple.

Robert Gibbs, Spring Hill, Mo.—This invention consists, first, in a peculiar mode of constructing and combining the clevis bar with its brace; second, in a peculiar construction of double hook for clevis bars or whiffletrees third, in a novel mode of swiveling the shank of a clevis hook in the clevis bar and combining it with a laterally adjustable front plate; fourth, in a new way of applying a hook staple to a swingle tree in connection with a perforated plate.

Improved Turpentine Scraper.

John G. Cobo, Shoe Heel, N. C.—This invention relates to turpentine scrapers which are used to detach the resinous substance that exudes from the tree, and consists in a double edged reversible scraper. This obviates entirely the employment of two implements to complete the operation.

Improved Carriage Protector.

George Bruce Brown, Newburgh, N. Y.—This invention consists in a plate provided with a subjacent and projecting strip of rubber applied in the rear of a carriage wheel and attached to the carriage spring by a curved arm and bifurcated holding piece.

Improved Sleigh and Sled Runner.

Jacob W. Karn and Eugene W. Karn, Watkins, N. Y.—This invention relates to the construction of sleigh runners, and consists in making the top rail bottom, runner, and intermediate supports of a single rod of metal.

Improved Wash Boiler.

Joseph Adams, Newark, Ohio.—This invention relates to the construction of parts which make up a wash boiler, and consists in a false bottom convex on top and provided with adjacent channel ways, the latter receiving the water from the former and delivering it to the steam generating chamber; also in a two part end-closed and side-perforated pipe, through which the hot water is forced in jets upon the clothes; and also in a perforated clothes shelf that fits over the pipes of the false bottom.

Improved Belt Hook.

Greenleaf Wilson, P. O. Box 1180, Lowell, Mass.—These hooks act on the same principle as pegging on the sole of a boot, the teeth taking the place of pegs. The belt is not weakened by punching holes; and, the teeth taking hold in so many places, the strain comes uniformly on the ends of the belt, which prevents tearing out the ends. The hook is particularly adapted for rubber belts. The inventor manufactures different sizes and supplies them by the quantity, at low rates.

Improved Machine for Cutting Hoop Locks.

John McGrew, Ravenswood, W. Va.—The invention consists in arranging a series of knives in a reciprocating holder, one above another, and each one projecting further out than the subjacent one, so as to cut out successive shavings from the shank. It also consists in an intermittent and laterally moving gage, that is automatically adjusted to each successive knife as the latter approaches the blank. It also consists in arranging inches on the knife holder, for the purpose of placing the gage in its proper relative position to each knife as it comes to its work. It also consists in providing the grooved uprights of the sliding tool holder with a separate and detachable cap, so as to permit an easy access to the said holder. It consists in a peculiar construction of cutter shanks, so that they may be readily applied and supported in grooves of holder.

Improved School Desk.

John Wallace Childs, Kansas City, Mo.—The invention consists in a peculiar mode of constructing the hinge joint of desk lids, and analogous articles, so that the desk lid is easily held by gravity in an inclined position for use, and lifted before it is allowed to fold against the back.

Improved Curtain Cord Fastener.

Charles Gammel, Utica, N. Y.—This invention has for its object to furnish an improved pulley for the cords of window shade rollers. A plate, designed to be secured to the window casing, is cast with a socket or hollow rib to receive a rod. The upper end or head of the rod is slotted to receive a pulley, around which is passed the endless cord by which the shade is raised and lowered. The rod is made considerably longer than the length of the plate, and has a hand nut screwed upon its lower end, so that, by simply turning the nut on or off, the tension of the shade cord may be adjusted as required. In the side of the rod is formed a groove, into which is inserted a pin so as to be entirely out of sight.

Improved Sofa.

William R. Conger, Newark, N. J.—The invention consists in the improvement of sofa bedsteads. The back is hinged to the frame of the seat, so that it will turn over and hang down. In this manner the lounge may be used as a double lounge whenever such use of it is desired. The back may also be fastened in an inclined position. To the front side of the lounge is attached an adjustable side or shield. When the lounge is in ordinary use, the shield is dropped down in front so as to be entirely out of the way. When it is desired to use the lounge as a bed, the front is turned up and fastened in any desired position. The head may be raised and adjusted to suit the occupant of the lounge.

Improved Telegraph Cut-out and Switch.

Robert Henning, Ottawa, Ill., assignor to himself and J. D. Caton, of same place.—The object of this invention is to substitute, for the different separate instruments used at present in telegraph offices as cut-outs and ground switches, a combination instrument which not only offers all the advantages of the former, but, by its simple construction, is clearly understood, easily operated, and furnished at less expense. The invention consists, mainly, in the combination of a cut-out and ground switch by means of two parallel metallic plates, connected with the line and local wires, which connection may be interrupted or established by the adjustable button or circuit closer and a metallic peg, which may connect either wire, or both, to the ground.

Improved Copy Holder.

Stephen French and Rufus D. Chase, Orange, Mass.—The invention consists of a board, supported in any way in an oblique position suitably for reading "copy." Near its upper edge is a pair of rolls with elastic surfaces arranged suitably for drawing a half sheet of paper along the table from bottom to top, one of said rollers being provided with a thumb bit at one or both ends for turning it. Just below the rollers is a slotted plate, arranged so that the paper, containing the matter to be copied, will be drawn under it and hidden from view, except a line or two which may be seen through the slot, and thereby be clearly indicated to the eye of the copyist, so that no time will be lost in following the copy in the right connection.

Improved Shank Laster.

Richard B. Perkins, Almond, N. Y.—The object of this invention is to construct a shank laster, which may be adjusted to different sizes of boots, holding the shanks firmly, and allowing the use of both hands in pegging. The invention consists of a curved main piece, with pinchers, guard, and regulator pivoted to the end thereof. The curved lever is placed under the knee, the pressure on guard and pinchers stretching firmly the shank leather for pegging.

Improved Cooking Vessel.

Laurence P. Bodkin and John S. Bodkin, Brooklyn, N. Y.—This invention has for its object to improve the construction of boilers, sauce pans, and other cooking vessels, in such a way that the liquid contents may be poured off and the solid contents retained. Upon the edge of the forward side of the boiler is formed a lip, inclining upward and outward, to serve as a spout in pouring out the liquid contents of said boiler, to guide them into the receiving vessel and prevent them from trickling down the outer side of boiler. Upon the inner side of the edge of the forward side of the boiler is formed a grate, the bars of which are connected with each other at their inner ends, and at their outer ends are formed solid with the body of the vessel. The bars of the grate are made triangular in form, and are so arranged as to form the least possible obstruction to the outflowing liquid.

Improved Railroad Switch.

John R. Adams, Sacramento, Cal.—The object of this invention is to construct a switch connection which avoids the disadvantages resulting from the expansion and contraction of the switch rail at different temperatures, causing either a too close contact, so as to prevent the working of the rail, or a too wide opening, so that the battering of the ends of the rails necessitates their replacement. The invention consists in the arrangement of an inverted rail under the switch rail, connected and pivoted to it at one end, and the extension of the lower inverted rail under a rest plate to the track rails, to which the same is also rigidly connected, producing an expansion and contraction in such a manner that the switch rail is always equidistant from the track rails, and no interrruption of the working of the switch or battering of the rails is possible.

Improved Folding Bedstead.

Alfred G. Bayles and John W. H. Carroll, New York city, and George D. Miner, Williamsburgh, N. Y.—This invention has for its object to improve the construction of the folding bed described in letters patent No. 133,137, issued to the said Alfred G. Bayles, November 19, 1872, so as to make it simpler in construction, and make it more nearly resemble a table or other similar article of furniture. The invention consists in an improved folding bed, formed of the two parts hinged to each other. One part has a molding around its top so that when the said part of the bed body is turned back the molding may swing out and serve as legs to support the weight, the cross bar of the molding supporting the weight, the hinges being simply intended to pivot the molding in place. The spaces in which the parts of the mattress rest are made of such a depth that the edges of three of the sides of the parts of the body of the bed may project sufficiently above the mattress to give space for the bed clothes. An end board is fitted into the open space formed by recessing the adjacent edges of the hinged sides of the parts when the bed is closed, so as to closely cover said opening. The edge of the part of the body opposite the hinges may be provided with a board, which, when the bed is closed, overlaps the other part and, when the bed is opened, serves as a head board to the bed.

Improved Feed Water Heater for Steam Boilers.

Sidney T. Taylor, Baltimore, Md.—This invention consists in a new arrangement of a cone and induction and eduction exhaust-steam pipes or tubes, with a perforated circular water discharge pipe, within a case or cylinder, whereby a very thorough absorption of heat by the water, and corresponding condensation of the steam, is assured. It also consists in providing a well at the bottom of the aforesaid case and arranging a piston and valve therein, so that the water accumulating in the case may be entirely removed.

Improved Sash Cord Guide.

William Shaw, Brooklyn, N. Y.—The case has flat surfaces in which is journaled the rod or pulley shaft, and the rollers or pulleys have end chambers combined with sets of loose balls placed in said end chambers, so as to take the pressure of the rollers and lessen the friction.

Improved Soldering Apparatus.

William D. Brooks, Baltimore, Md.—This invention relates to means for avoiding the necessity of changing the circle of blow pipes at every change in the size of cans to be soldered, and consists in a novel and peculiar mode of attaching the burner pipes to their supply chamber.

Improved Butter Worker.

Warren N. Golden, Coldwater, Mich.—This invention consists in butter workers having paddles with peculiarly shaped end curve and flat surface; and in the combination with two butter workers and one butter holder of a circular rack and pinions, arranged so that all the former may be simultaneously operated from a single crank arm.

Improved Harvester.

Wm. K. Rairigh, Plumville, Pa.—This invention consists in making the shaft that drives the cutter pinions in three sections, easily applicable to and removable from each other, and in making the seat to slide back and forward at the will of the driver.

Improved Veneer Cutting Machine.

John W. Leslie and George R. Smith, Cairo, Ill.—This invention consists in the employment o. a pressure roller so small that the curvature of the periphery will admit of the application of the pressure exactly opposite the edge of the cutter, with two secondary pressure rollers acting upon it to make up the capacity for pressure, in which it is considerably reduced by beingmade so small. The object is to lessen the checking of the wood, which is considerable in the machines using only one roller, because the size necessary for strength makes the curvature so large that the point of contact with the wood must be considerably in front of the cutting edge.

Improved Extension Settee.

Cornelius Beatty, Elizabeth, N. J.—The object of this invention is to so construct settees or "lounges" that they may be readily converted into beds for sleeping purposes; and it consists in the mode of extending the settee by sectional extension side pieces hinged thereto and provided with legs, the same being so constructed and arranged as to be folded back around the settee and fastened together.

Improved Sewing Machine.

Cyrus Lewis and Joseph Soothill, Howard, Ill.—The invention consists in means for facilitating the application of glass to bearing surfaces. The vertical wall of the shuttle race and the bottom are of glass. The glass race is supported by a metal plate to which it is fastened by detachable clips at the ends. A groove or a slot is made in the part for the needle. The glass race is bedded thereon, on its metal supports, in cement, shellac, or other elastic substance calculated to back it throughout, take up the shock, and prevent fracture.

Improved Compound Explosive Projectile.

Frank A. Markley, Waynesborough, Va.—The object of this invention is improvement in the class of shells or explosive projectiles which are formed of several detachable parts; and the improvement consists in the construction of the projectile whereby the several auxiliary shells or chambers are connected to the main cylinder. On the ignition of the fuse connection, the powder charge in the main chamber explodes and throws the quarter shells in different directions. The fuse of each shell will take fire from the first explosion and ignite the powder charges of the auxiliary shells, scattering their fragments again with powerful effect.

Improved Water Wheel.

Alisha B. Reniff, Bingham's Mills, N. Y.—This invention has for its object to furnish an improved water wheel. Around the body of the wheel is formed the inner rim. The inner edges of the buckets are secured to this inner rim, and to their outer edges is secured an outer rim. The buckets are so arranged that their upper edges are about upon a tangent with the rear side of the shaft. They also incline to the rearward, and their inner side edges pass to the rearward faster than their outer side edges, and are made longer, so that their bottom edges may be horizontal. The inner rim is made deeper than the outer rim which, in connection with the form of buckets, causes the wheel to discharge freely. The wheel when at work in connection with the spent water causes a suction, which renders the use of a suction pipe wholly unnecessary. The size of the buckets and their number may be varied according as more or less power is required. The body of the scroll or stationary wheel is made convex upon its upper side and horizontal upon its lower side. The lower edges of the chutes are arranged about upon a tangent with the forward side of the shaft, and are inclined in the opposite direction from the buckets. This construction of the stationary wheel allows the water to pass readily and freely into the chutes, and enables the wheel to be run effectively with a very low head of water.

Improved Wheel Cultivator.

John H. Randolph, Jr., Bayou Goula, La.—The invention consists in the improvement of cultivators. The tongue of the machine is attached to the cross bars of the horizontal frame and strengthened by inclined braces. To the near cross bar of the frame are attached a pair of vertical standards, placed at such a distance apart as to receive one of the drive wheels between them. The drive wheels are placed upon shafts and carry the same with them in their revolution. The shafts revolve in bearings, while their inner ends project through keepers on long bearings attached to a standard, so that the latter may be raised and lowered without disturbing the shafts. Upon the forward edge of the standards are rack teeth into which gear the teeth of a segmental toothed wheel, the hubs of which are placed upon shafts to which are rigidly attached the lower ends of the levers. Plows or scrapers are attached to the lower ends of the standards, and are so formed as to move the soil inward or toward the plants. By means of blades actuated by radial arms suitably arranged, the soil is thrown toward the plants, said blades operating upon the soil somewhat as the blades of a propeller screw operate upon the water. The blades may be used in connection with the plows, or either may be used without the other, and both may be adjusted to work at any desired depth in the soil.

Improved Swaging Machine.

Henry M. Crippen, Bartlett, assignor of one half his right to James C. Wilson, Plymouth, Ohio.—The object of this invention is to furnish a machine for the use of carriage smiths and metal workers generally, by means of which the time and labor required for forging the various light irons required in the prosecution of their business may be greatly diminished and the work performed in a superior manner. The bed plate of the machine is elevated on an iron frame and supports a stand. Vertical rods are held in the jaws of this stand, upon which are spiral springs. The bar which carries the upper swages rests upon the top of the spiral springs. The rods, with the bar connected, play freely up and down in the jaws. The down action is produced by means of a treadle. The back or upward motion is produced by the recoil of the spiral springs. The die plate has on its face grooves which correspond with the grooves in the faces of the hammer dies, and is moved and adjusted on the bed laterally to suit the operator, and may be secured in any desired position.

Improved Paddle Wheel.

James C. Chaffee, Titusville, Pa.—The shaft is connected with the driving power by cranks to which are attached hubs made with pairs of parallel flanges to receive the inner ends of the paddles. To said ends are secured the paddles bent in the middle, flanged on their outer ends, and bolted to disks. Upon the outer edges of the disks are formed flaring rims to protect the buckets from obstructions in the water. This construction, the paddles being set opposite to each other, makes the boat more steady and renders the wheels less liable to clog than wheels constructed in the ordinary way.

Improved Harvester.

Wm. K. Rairigh, Plumville, Pa.—This invention consists in combining an adjustable reel with a set of pulleys and cords so that the said cords and belts will always be automatically tightened or loosened whenever the reel is changed; in a pivoted reciprocating rake that is held upright on the off-stroke but tipped over by a spring ready for the on-stroke; in a wire frame gatherer attached to a detachable guide frame; and finally, in operating the rake by a shaft having two reversed and crossing spiral slots.

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Notes & Queries

J. H. P. asks for a good recipe for blacking or painting a portable boiler, so that it would retain its gloss.

G. F. C. asks where a description of the electro-plating process of Messrs. Jacobs and Klein may be found.

E. A. J. asks: With an area of steam pipe of 1 square inch, and a pressure of 50 lbs. per gage, if the steam flowed into a vacuum, with what force would it strike a disk suddenly slid over the opening?

B. F. J. asks: What is the striking power of the largest hammer used in Burden's horseshoe works; also of the largest one in use anywhere else? [Perhaps some of our readers who have seen the hammer mentioned will forward some information on the subject. The largest hammer in the world is supposed to be the 100 tun hammer at Krupp's steel works in Prussia.—EDS.]

W. B. asks for a recipe for cement which can be applied around the joint of a tin box, which will keep oil from coming out during transportation. When the box and contents reach the destination, the cement is to be removed. "I do not wish to solder the cover on, but merely to keep the oil from oozing out."

J. N. H. asks: Will a turbine wheel give as good results for power as an overshot, the amount of water being from 100 to 300 inches in volume, and the fall 20 feet? Both wheels are proportioned to that amount. A man was desirous of putting in a turbine wheel: but a millwright said it would do well enough in the spring for a month or two when water was plentiful, but in low water it would not do the work that an overshot would. [The question proposed by our correspondent is one of great interest, and we would be glad to hear from those of our readers who have information on the matter. Some turbine wheels have given an efficiency of more than 85 per cent, but there is generally a great falling off at "part gate."

Answers to Correspondents

R. will find full directions for kalsomining on p. 350, vol. 24.—J. C. S. will find a rule by which he can obtain the required width of belt on p. 257, vol. 28.

J. H. B. asks: Can glass be made into solid balls of from 3½ inches to 5 inches diameter, and what would be the cost of common glass in that shape per ball? I am informed that it cannot be done, as the glass would crack in hardening. Answer: Those who have worked in glass houses say there would be no danger of the glass cracking if annealed. We cannot tell the price.

E. S. asks: What will remove iron rust from carpenters' tools? Answer: Very dilute sulphuric acid will dissolve rust from iron or steel. It must then be carefully washed, thoroughly dried and oiled. Paraffin will protect iron from rust.

B. W. F. asks (1) for a recipe for making "Pharaoh's serpents". 2. How are a number of clocks kept regulated by means of galvanic connections? 3. How can I make a cheap electric alarm bell? I have batteries and an electro magnet. Answers: 1. See answer to C. R., in another column of this issue. 2. A series of electric clocks are run by having first a standard clock so arranged as to make and break the electrical circuit at each oscillation of the pendulum. When contact is made, an impulse of electricity is sent through the wires connecting the clock with the indicators. These indicators in their most simple form are merely ordinary clocks, marking seconds, with the driving mechanism and pendulum omitted. In place of the pendulum there is an electro-magnet so connected with a bar of iron that every time the circuit is made the bar of iron is attracted and pushes the second wheel forward one tooth. As soon as the circuit is broken, a spring retracts the bar of iron, and it is ready for another beat. Perhaps an easier method for converting an ordinary clock into a copying clock or indicator, if you are not a clock maker or brass founder, is that described in Rolfe & Gillet's "Cambridge Physics." It is to simply disconnect the driving power (spring or weight) and remove the pendulum ball. In place of the latter, attach to the pendulum rod a coil of insulated wire, and attach to the sides of the clock case two permanent magnets in a horizontal position with their south poles toward the ends of the coil. When a current passes through the coil one end acquires north magnetism, and is attracted by the magnet near it, the other end becomes south and is repelled. The regulating clock now reverses the direction of the current and the pendulum coil is carried to the opposite side. 3. You may attach a small electro-magnet to a spring, so as to prevent the clock work from ringing the alarm bell; when the current is broken the spring is released and the bell rings; or the bell can be rung by electricity.

C. A. asks what kind of varnish is used for the process of etching designs in glass plates. The use of the varnish is to prevent the action of the hydrofluoric acid upon the parts of the plate which are not to be etched. Answer: A very good etching varnish is made by dissolving wax in turpentine; but for a small plate of glass, it is better to warm it gently and apply the wax which melts and flows evenly over the surface, as the turpentine varnish sometimes remains sticky and soft. Engravers etching ground can be used on either glass or copper. It is made of 2 ozs. white wax, ½ oz. black pitch, and ½ oz. Burgundy pitch, melted at a moderate heat; then stir in 2 ozs. powdered asphaltum and boil. Pour the mass into water and work into balls, which are tied up in smooth worn silk and applied to the plate warm, when it oozes through the silk. A dauber of soft wool covered with silk is used to smooth it perfectly.

A Lady asks if camphor put up with furs causes them to fade. Answer: Persons who have used camphor for a long time do not notice any change of color, even where the gum is in direct contact with the fur.

W. A. S. says: Herewith enclosed please find a section of lead pipe, cut from a piece eleven feet long; the whole length is perforated like the sample sent. We are somewhat puzzled as to the cause of decay. The pipe was put down, six feet below the surface of the ground, nine years ago, as a conductor of pure water from the main pipe into a building. The soil is dry, sandy and pebbly. Attention was first called to it by the leakage, through the stoppage of water in the building. Believing that it would be interesting and instructive, we ask your opinion. Answer: The specimen appears to have been gnawed by some animal, but it may have been corroded by some mineral acid in the soil, which attacked the lead. Such cases are not common.

W. H. P. says: I have been using the following arrangement for over a month, and I find it to surpass anything of the kind in use. The object is to pump water into a boiler without diminishing or stopping the making of steam. Set the check valve on the center of the boiler, thence run a pipe (inside the boiler) to the front end, elbow it and run it to the back end, and to within an inch of the bottom; so that, as a natural consequence, by the time the water passes through that length of pipe in the steam, it will be as hot as it would be when it gets to the water in the boiler. Please give me your opinion. Answer: If the water is heated by the steam in the boiler, it must, of course, abstract heat from the steam, so that our correspondent's arrangement, while it is efficient, may not be economical.

J. B. F. asks: What is the most suitable engine for driving a street car, that is, the one that would do the work with the least steam? What is the weight of the engine and the amount of steam required to run one of the dummies now in use? Answer: It would require too much space to answer our correspondent's inquiries in full. By consulting back numbers of our paper he will gain considerable information on the subject. Opinions differ as to the best form of engine for street cars. We have seen an account of a steam car containing an engine of 5 horse power, and consuming coal at the rate of one tun every thousand miles of continuous run.

D. C. says: A low pressure engine has a condenser, and I notice that it does not carry so much steam as a high pressure; what is the reason? If I were to put a condenser on a high pressure engine, would it be called a low pressure or a condensing engine? Answer: In common parlance, a low pressure engine is one that has a condenser, and a high pressure engine exhausts into the air. Modern condensing engines frequently carry as high pressures as non-condensing engines; and the names condensing and non-condensing are the most appropriate. A condenser and air pump can be attached to any non-condensing engine, and it then becomes what is commonly known as a low pressure engine. In this case, the initial pressure of the steam can be reduced—or the valve may be altered so as to cut off the steam at an earlier point of the stroke; and the engine will then develope the same power as before.

C. A. B. says: A hydrostatic press having a cylinder whose internal diameter is 8 inches and external diameter 18 inches (thickness of metal 5 inches), the tensile strength of the material being 16,000 pounds per square inch: what pressure per square inch will it take to burst the cylinder? I find so much difference between Rankine and Molesworth that I ask you to give an explanation. Answer: The bursting pressure per square inch will be nearly 9,000 pounds. The rule given in Molesworth is derived from experiment, and is applied to thin cylinders and pipes of cast iron, under given conditions. See article on thick cylinders on page 384.

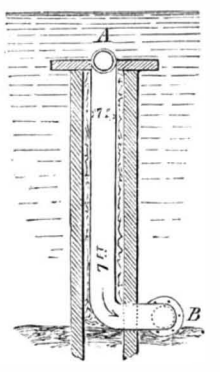
J. E. P. says: Suppose that a steam pump shows 50 lbs. steam on boiler with throttle wide open, and say 100 lbs. water pressure, throwing 150 feet through 1¼ inch nozzle. If I connect another engine of the same capacity with the same amount of steam and water pressure, with the throttle wide open, to the same line of hose, using the same nozzle, will the two combined increase the pressure on the hose or throw a greater distance than the single engine by itself? Answer: The effect of connecting the second engine will be to force more water through the hose in a given time. The pressure per square inch on the hose will be increased, and the water will probably be thrown farther.

Y. M. says: 1. With a cylinder 1½ inches bore x 3 inches stroke and a slide valve, would a shaft ⅝ inch diameter be stiff enough for the fly wheel and crank, or should it be ¾ inch? 2. The boiler is 18 inches long x 10 inches diameter, and is to have two flues 2½ inches diameter through it. The fire is under the boiler, from which place it goes to the back end, and returns through one flue and then through the other to the smoke stack. Would a boiler of that size be large enough to run an engine of the size mentioned at 150 revolutions? The boiler is made of copper three thirty-seconds of an inch thick. It is to be fired with shavings, etc. 3. How many pounds pressure ought it to stand per square inch, and how many pounds would it require to run it at the speed mentioned, to drive a lathe 6 inches swing, turning 21 inches long, either iron or wood? Answers: 1. A shaft, ⅝ of an inch in diameter, would be large enough. 2. You will find remarks on the performance of small boilers, in previous numbers of our journal. 3. The boiler ought to stand a pressure of 80 or 90 pounds to the square inch, and drive the lathe with a pressure not exceeding 60 pounds.

J. E. E. says: 1. I want to set the valves of a locomotive engine. Please give the simplest mode of placing eccentrics in the right position on axle, the position of the reverse lever, and the lap and lead of the valves. 2. For a four horse stationary engine, what should be the size of the boiler, number of flues, pressure per inch, number of strokes per minute, and size of cylinder, valve seat, and valve. Answers: 1. You will find details as to size of ports and methods of setting slide valves in "Link and Valve Motions," by W. S. Auchincloss. It would take too much space to give you all the information you ask for in this column. 2. Make the cylinder 4 inches diameter and 6 inches stroke, with a piston speed of 200 feet per minute. The boiler should have from 60 to 70 square feet of heating surface; and the steam pressure should be about 70 pounds per square inch.

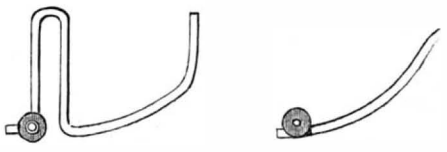
F. C. B. asks: 1. How is the oxide of manganese put in around the carbon plate of a Leclanché battery? Is there any other substance with the coke? 2, How can I make nitrate of silver? Answers: 1. The carbon plate is placed inside the porous jar, which is then almost filled with the crushed peroxide of manganese, and sealed with melted asphalte. A solution of chloride of ammonium is used outside to act on the zinc. 2. Reduce a silver coin to filings, by means of an ordinary file or rasp, dissolve the filings in more or less nitric acid, according to the strength of the acid, and evaporate the solution until the salt will crystallize; any excess of acid will be driven off in the process of evaporation. The copper of the coin will not interfere for ordinary use, but pure silver may be obtained from almost any dentist.

F. W. says: I have a stream of water, but no spring for feeding a hydraulic ram; and at the point where I want to use the water the fall has little weight, but has a depth of 7 or 9 feet. The river carries in the driest season about 800 cubic feet of water per minute. I propose to fix substantially a cast iron pipe to the bottom of the river, as shown in the engraving. The pipe and its supports act as a kind of dam and prevent an admission of water, except from the surface at mouth of pipe at A. This would create a fall of 9 feet at high water in the river. The perpendicular part of pipe has a length of 7 feet inside and a diameter of 7 inches, and 7 inches gives an area of 38·484, which, multiplied by 9 feet fall, shows 1,980 gallons per minute. According to your article about hydraulic rams, the 1,980 gallons falling 9 feet would raise 280 gallons per minute to a hight of 63 feet, or one seventh the quantity descending. Forty per cent of this would be 112 gallons. A good deal less would be enough, if a constant stream to a reservoir on top of bank could be had, without further aid or power. Any water engine or the ram can be screwed to the border at B. If the fall of said quantity of water will not create, *per se*, a rise of water to the hight of 63 feet in smaller streams, which is the best way to effect it? Answer: The pipes would simply fill up and no result would follow in the desired direction. If there is no available permanent fall, no water can be raised, even with the hydraulic ram.



J. A. B. says: I noticed on page 210 of your current volume an article on a large magneto-electric machine, copied from *Engineering*. For some time past I have been anxious to make an electric light, and I thought I might possibly make a magneto-electric machine myself, large enough to show the spectrum of the metals, etc. I noticed that, in reporting Tyndall's first lecture in your journal of January 4, you say that he used a small voltaic battery for his light. I wish to have some apparatus to experiment with. Part of this apparatus, I have already finished, such as bisulphide of carbon prisms, clockwork for rotating colored cards, etc. I wish to ask you: Which would you advise me to use, a series of batteries or a magneto-electric machine? 2. Are Bunsen elements the best? 3. What would be the smallest number to use so as to get a good light with a Dubosc lamp? Answers: 1. A series of batteries. 2. Bunsen's are most generally used. 3. It will depend on the amount of light wanted, and the time it is required to be kept up; five cells will give a good light. Thirty No. 1 Bunsen cells will give a good light for your purpose, provided you scrub the zincs with a wire brush when you are through; the price per cell is about $1.75; the running expense is the zinc and acid; the zincs you can cast yourself, using one new zinc as a pattern. Nitric acid is about 12½ cents per lb. Sulphuric acid is 3 cents per lb.

S. L. G. asks: How much power could I get from a stream of water 1½ inches in diameter, with about twenty feet fall? I would have to carry it about a mile in pipes to get that much fall. Would it be necessary to run the pipe thus, or would it do as well thus



with wheel at the bend? Answer: An inch pipe a mile long would discharge too little water to be of any use. With a pipe sufficiently large to discharge the required amount of water under a head approximating the amount due the grade, it would make no difference which of the proposed methods of termination was adopted.

J. C. L. says: In your answer to N. B. D., on page 367 of your current volume, I think you do not get at the idea in regard to electro-magnets. He says he has 600 feet of fine covered wire on which is too much resistance for any ordinary local battery to overcome. There is wire enough for a relay, or intensity magnet, as it is sometimes called, requiring a battery of 8 or 10 Bunsen cells to have first rate effect. A local sounder has only about 100 feet of No. 23 wire, and that is as much as a local battery wants to do. Answer: We respectfully differ. We will produce a sharp click of the armature with an electro-magnet of No. 30 wire and of fifty Ohms resistance, and only use a battery formed of two copper pennies and two zincs of same size, in dilute sulphuric acid; the same battery will produce no noticeable effect on the armature of a magnet of coarse wire of less than one Ohm resistance, but, conversely, using five Daniell's cells. The second magnet will hold its armature with about three times the force of the first, both armatures being of the same size and under the same recoil tension. N. B. D.'s magnet, if properly made, is suitable for obtaining the most attractive force from a very slight current of electricity; but if he wishes to obtain the greatest magnetic effect from an ordinary local battery on short circuit, then he should use, as you say, coarser wire and less of it. Telegraph instrument makers try to follow this rule: Have the resistance of the electro-magnet wire equal to the resistance of the battery and the wires connected with it. N. B. D. did not mention the particular use for which his magnet was intended, and for this reason we did not mention that the fineness of the wire was a probable mistake.

B. F. W. asks: What should I use to deaden the sound in smut machines, where the grain is cleaned by scouring against the sides of an upright iron cylinder? We place a wood hoop around it, having a space of from 3 to 5 inches between the two; with what can we fill the space, cheaply, to produce the desired result? Answer: The sound would be deadened in the most perfect manner by exhausting the air from the space between the hoop and the cylinder.

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A. S. R. asks: 1. If an article weighs one pound at the pole, ought it not to weigh very much less at the equator, from the greater centrifugal force at the equator caused by the daily revolution of the earth? 2. If centrifugal force, caused by the revolution of the earth has any influence on a body on the surface of the earth, and if there is not a corresponding difference in the weight of the body at the equator and at the poles, would not the fact conflict with the general idea of the laws of gravitation? Answers: 1. The force of gravity at different points of the earth's surface is diminished by the centrifugal force in the ratio of the square of the cosine of the latitude. Hence, a body is lighter at the equator than the poles, and a body which weighs one pound at the pole will weigh about 995 of a pound at the equator. In general, it may be stated that the weights of a body at the equator and at the pole are in the ratio of 194 to 195, or that 194 pounds at the equator will be 195 pounds at the pole.

D. D. A. asks: 1. Which is the most likely to roll over or upset, a long boat or ship or a short one, supposing the width and depth of hold in both instances to be the same? 2. Which is the staunchest, or rather, which has the greatest strain on it, a long boat or ship or a short one, if in both instances they have a proportionate width and depth of hold? Answers: 1. Other things being equal, a long vessel has greater stability than a short one; or in other words, the long vessel has a stronger tendency to right itself quickly on being heeled than the short one. 2. We do not understand exactly what our correspondent means by this question A long vessel is ordinarily more strained than a short one, and requires to be made stronger.

J. C. asks: Has stone been used in a steam boiler for a float? Answer: The device mentioned has been frequently used in a boiler, a counterpoise being placed outside. A kind of sandstone has been commonly employed.

F. A. M. asks: What is the cause and preventive of the foaming of the water in my boiler? It occurs only when the engine is in motion. The boiler is a 10 horse power upright: the feed water is very pure well water. When the engine is at rest, I can tell just where the water is, but when I start it, if the water is at the lower gage, it will often come out at the upper, and if it is at the second gage and near the third gage, it will overflow into the engine for 15 minutes after it is started. I run with about 50 lbs. of steam. No matter how soon we try the gages, after the steam is shut off from the engine the water is at rest; but the instant the throttle valve is opened, the upper gage will show water, when before only the lower gage showed it. Answer: Your boiler primes because the steam space is too small. If you can increase the pressure and keep the throttle valve but partially open, you may remedy the trouble. If, however, the water only "lifts" in the boiler, without being carried over into the cylinder, it does no harm, provided that you are careful to have enough water in the boiler so that, on stopping the engine, the flues will not be uncovered when the water level falls.

E. G. S. asks: How can I best conduct sound through 1,500 feet distance? I have been told that gas pipe is good; if so, what kind and what sized pipe is best? Answer: The ordinary speaking tube, with mouth pieces and whistles, will probably answer your purpose. Any good plumber will fit it up for you.

G. F. S. asks: 1. What are the best sized ports for a 4 inches bore steam cylinder? 2. What size in the bearings ought a solid cast iron crank shaft to be made to insure sufficient strength for the said cylinder, the bearings being 6 inches apart? 3. Does it cool the water much faster in a boiler to pump in at the top of fire box than at the bottom of boiler? Answers: 1 and 2. Sufficient data are not given. The length of stroke, length of posts, steam pressure and number of revolutions would be required to answer the question. 3. Under ordinary circumstances, the feed should enter the boiler at a low point.

A. S. asks: 1. What is the cause of our steam pipes splitting, when the condensed steam cannot get out? They will stand the pressure of the steam. We had a two inch pipe split last Saturday, and there have been many of them split through the winter. I do not think that it is the frost. 2. What is the best and cheapest way of heating water to feed our boiler? We have thought of putting a coil of two inch pipes into the chimney and pumping through them, and we set the pump low to let the water run into it, but the pump got so hot that it would not work. 3. We have been burning sawdust in our boilers, and there is a hard crust inside the tubes: it is difficult to get it off. Is it the wet sawdust that causes it; and if so, what is the best means of cleaning it off? Answers: 1. The pipe was probably split by the concussion of the water. When steam is admitted into a cold pipe it condenses, and the rush of steam forces the water with great violence against the pipe. Put drain pipes at the lowest points. 2. It is better to force the water through the heater than to draw from the heater. If the exhaust steam from the engine passes into the chimney, the plan you propose will probably give satisfaction. 3. If the crust cannot conveniently be removed by a scraper, it may be loosened by a jet of steam. This can be readily directed by means of a small rubber tube.

J. H. D. asks: 1. If I send you sample of boiler scale, could you tell me what the impurities of the water are; or could you tell better from a sample of the water? The water will eat holes in an inch iron gas pipe used for running it in about one year. 2. Is it possible to make a siphon work over about 33 feet, or any further than a common pump will lift water? Answers: Probably the impurities of the water could be determined by simple inspection of the scale and some remedy could doubtless be found. 2. No.

F. L. S. asks: 1. What is the difference between tannate of soda and common washing soda? 2. What quantity should I put in a boiler of 25 horse power? Our boiler is thick with scale and we have to stop and pick it off once in six months. The scale has a dark slaty appearance. Answers: 1. Washing soda is a hydrate of soda, or a compound of the oxide of sodium and water. Tannate of soda is a compound of soda and tannic acid. 2. The amount of the compound required in a boiler depends largely on the nature of the water used, and the amount of scale already deposited. Try 25 pounds in your boiler; and at the expiration of a week, clean out the loose scale. In a few weeks, you will be able to determine, by the condition of the boiler, whether to use more or less of the compound.

T. F. D. asks: 1. Will water rise higher than the level of the reservoir from which it is taken, when forced by the pressure of the water through a pipe from the bottom, the end of said pipe being higher than the main level? 2. Which is the proper way to use a reamer on cast iron for general purposes, dry or with oil? 3. Where are the termini of the first Atlantic cable to this continent? 4. Are visitors allowed to go into the printing offices of any of the daily or weekly papers? Will they be allowed to go through the SCIENTIFIC AMERICAN printing office? Answers: 1. No. 2. Dry 3. The American terminus is at Trinity Bay, Newfoundland, and that on the other side is at Valentia Bay, in Ireland. 4. Printing and publishing rooms are private establishmen s; but in general, visitors are allowed, by courtesy, to inspect them.

C. N. D. says, in reply to B., who said that sulphuric ether would not dissolve rubber: Use chloroform; you will find that it will dissolve readily.

MINERALS.—Specimens have been received from the following correspondents, and examined with the results stated:

H. M. B.—Quite pure red hematite iron ore.

C. A.—It is flint.

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On the Precession of the Equinoxes. By J. M.

On the Million Dollar Telescope. By R. H. and by V.

On the Stages of Invention. By S. H. H.

On a Coal Dust Burning Furnace. By —.

On Soap. By F. E. W.

On a Fly Destroyer. By J. C. C.

On Deep Sea Soundings. By L. de W. and by H. N. C.

On Storm Signals. By A. W.

On Retrogressive Motion of the Sun. By J. H.

On Meteors and Meteorites. By D.

On Trisection of the Angle. By P. H.

Also enquiries from the following:

W. S. G —W. F.—G. S. C.—J. F.—J. H. M.—W. D.—J. B. H.—H. A. W.—J. H. D.—P. Q. L. R.—S. W. E.—S. J. W.—J. S. J.

Correspondents who write to ask the address of certain manufacturers, or where specified articles are to be had, also those having goods for sale, or who want to find partners, should send with their communications an amount sufficient to cover the cost of publication under the head of "Business and Personal," which is specially devoted to such enquiries.

[OFFICIAL.]

Index of Inventions

FOR WHICH

Letters Patent of the United States

WERE GRANTED FOR THE WEEK ENDING

May 20, 1873,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

Angling fly, J. Mullaly	139,180
Auger handle, S. W. Hemenway	139,006
Augers, forming the lips of, J. Swan	139,091
Augers, coupling for earth, T. Uril	139,092
Axle box cover, Moyel & Howell	139,179
Basket form, A. F. Scow	139,025
Bell, door, A. A. Stewart	139,206
Bell ringing, J. Harrison	139,147
Blind slats, entering, J. Church	139,013
Boiler alarm, milk, S. Mangold	139,092
Boiler feed, etc., F. A. Fischer	139,136
Boiler flue thimble, J. C. Farmer	138,998
Boiler water alarm, etc., R. Safely	139,194
Boot sole plane, B. J. Tayman	139,034
Boot tip, detachable, M. R. Hawley	139,066
Boots, etc., sample holder for, J. Closs	139,044
Boot, attaching heels, etc., Ellis & Glidden, (r)	5,413
Box lifter, B. H. Smith	139,029
Box or can for paints, etc., H. Tucker	139,214
Box, packing, D. L. Bartlett	139,106
Branding apparatus, J. W. Dodge, (r)	5,420
Bricks, repressing, J. K. Caldwell	139,113
Building blocks, forming, A. Derrom	139,050
Building materials, elevating, J. King	139,161
Bureau and ironing table, W. W. Adams	139,101
Bustle, H. H. May, (r)	5,416
Cake cutter, J. Webster	139,217
Can, C. A. Murdock	139,181
Can for oil, etc., metal, G. W. Banker	138,986
Cane, M. Osborn	139,020
Car coupling, B. D. Moody	139,016
Car coupling, E. Wiley	139,221
Car, reversible street, W. T. Jenks	139,063
Car starter, G. Felter	139,134
Cars, brake for coal, D. Wetsel	139,097
Car pipe coupling, M. Henszey, Jr	139,150
Carpet beater, W. H. Hankinson	139,145
Carriage top, G. H. Young	139,225
Carriage running gear, Kline & Jack	139,164
Caster, J. Toler	139,212
Casting scabbard ornaments, V. Price	139,028
Centrifugal machine, E. J. M. Becker	139,108
Chain machine, B. Hershey	139,151
Chair fan, rocking, O. Brueck	139,112
Chair, tilting, M. V. B. Howe, (r)	5,419
Chandelier, J. Kintz	139,066
Chimney cowl, J. H. Richardson	139,086
Chimney and fireplace, J. Briggs	139,111
Churn motor, J. B. Sweetland	139,208
Cigar trimmer, A. Hettinger	139,152
Clay, pulverizing, G. C. Bovey	139,110
Clock striking works, Leeds & Thorpe	139,166
Cloth, stretching and drying, W. Bailey	139,038
Clothes line pulley, G. H. Ryer	139,024
Clothes pressing machine, H. E. Smith	139,201
Clothes wringer, H. E. Smith	139,200
Clutch, friction, E. Allen	138,980
Copying press, letter, G. C. Taft, (r)	5,417
Cornice, stucco, A. Derrom	139,049
Cotton worm destroyer, J. Helm	139,062
Coupling, union, W. B. Snow	139,203
Cultivator, E. M. Graham	139,001
Cultivator, R. Rust	139,193
Cultivator, rotary, R. McKinley	139,018
Darning machine, B. Arnold	138,981
Darning machine, B. Arnold	138,982
Dental drill, J. W. Baxter	139,039
Dental fillings, block for, C. H. Mack	139,012
Digger, post hole, A. E. Lindsley	139,169
Doll joint, J. A. H. Ellis	139,130
Door check, G. E. Rittenhouse	139,082
Drill, seed, E. G. Matthews	139,074
Drilling stock, G. Bunch	139,012
Drop light, center slide, C. Deavs	139,123
Dyeing madder colors, F. A. Gatty	139,056
Edging machine, Gronberg & Ferry	139,142
Eggs, etc., preserving, J. Connell, Jr	139,116
Elevator, J. S. Baldwin	138,985
Engine, compound steam, C. E. Emery	139,052
Engine governor, steam, E. Ware	139,096
Engine variable cut off, W. Wright	139,224
Explosive compounds, E. A. L. Roberts	139,193
Eyeleting machine, A. Dawes	139,048
Feather renovator, S. G. Thanhauser	139,211
Filter for water coolers, C. Schneider	139,085
Fire arm, breech loading, T. Restell	139,190
Fluting machine, Madden & Dodsworth (r)	5,415
Fruit jar, T. B. Carroll	139,115
Fruit jar, sealing, R. S. Manning	139,170
Fruit picker, H. Mewes	139,015
Furnace feed attachment, D. Morey	139,075
Gage, speed, J. W. Osborne	139,184
Gas, manufacture of, F. A. Sabbaton	139,083
Gas purifier and regulator, J. A. Enos	139,131
Gate, farm, Westbrook & Clemmons	139,219
Glass coffin, J. N. & T. Wallis	139,095
Governor, R. W. Gardner	139,055
Grain binder, S. D. Locke	139,008
Grain, elevating, etc., H. I., P. F., & E. D. Chase	139,594
Grain, ventilating, B. Dunwiddie	139,126
Grater, vegetable, McNeir & Stockton	139,173
Hair curling, E. F. Crain	138,995
Harrow, T. M. King	139,065
Harvester, J. S. Davis	139,122
Harvester, H. J. Silvernale	139,199
Hat blocking machine, E. C. Fales	139,133
Hatchway protector, J. W. Meaker	139,014
Hatchways, closing, J. S. Baldwin	138,984
Hedge hook, E. S. Turner	139,215
Heeling machine, Glidden & Fairfield	139,058
Horses, detaching, H. Latshew	139,038
Horses, treating, D. Sullivan	139,207
Hose coupling, Wilson & Kendall	139,223
Jack, lifting, W. A. Brunker	139,041
Jelly glass, D. C. Ripley	139,081
Knife cleaner, T. & L. Gingras	139,057
Knitting machine, W. & W. Campion	139,114
Ladders, elevating, A. Miller	139,175
Ladder, step, Oakley & Post	139,183
Ladder, step, Hardenbrook & Belford	139,004
Lamp, J. E. Ambrose (r)	5,412
Lamp heater, W. Triel	139,140
Lantern, T. Smith	139,030
Last, I. N. C. Saville	139,196
Lathe for turning wood, Smiley & Small	139,028
Lathe for turning wood, A. R. Park	139,076
Lithographic press, C. C. Maurice	139,171
Lock for sliding doors, A. W. Cram	139,118
Loom stop mechanism, C. Barnes	138,987
Mail bag, T. J. Hardaway	139,031
Mantel, false, J. T. Fleehearty	139,137
Mattress, H. E. Smith	139,202
Mattress, E. Parker	139,077
Medical compound, J. Conzelman	139,045
Medical compound, T. B. Owens	139,185
Mills, grater for cider, W. Barr	139,105
Mill feeder ore, C. P. Stanford	139,204
Music leaf turner, J. H. Gerry	139,141
Nut and coffee roaster, D. T. Gale	139,054
Oil tank, self-measuring, J. Schalk, Jr	139,084
Oil wells, cleaning, J. J. Looney	139,010
Pad, etc., metallic sweat, J. M. C. Bennett	139,990
Paper bag machine, H. G. Armstrong	139,104
Paper clip, T. Orton	139,019
Paper collar die, Harrington & Rollins	139,146
Paper cutter, rotary, H. S. Miller	139,176
Paper feeding machine, J. T. Ashley	138,983
Paper washer, E. S. Hanna (r)	5,422
Pavements, composition for, G. L. Eagan	139,127
Petroleum, treating heavy, J. J. Looney	139,009
Photographic camera, E. P. Spahn	139,090
Photograph burnishing press, Entrekin & Bramble	139,132
Piano lid prop stick, M. Doherty	139,125
Pipe stems, bending, J. Harvey	139,148
Pipe tongs, F. H. Merrill	139,174
Planter, corn, A. H. Stark	139,205
Planter, corn and cotton, Savage & Doty	139,195
Plow, L. Gibbs (r)	5,421
Plow, G. B. Vaughan	139,036
Plow, wheel, I. B. Green	139,059
Plow, wheel, C. B. Stevens	139,032
Pocket openings, fastening, J. W. Davis	139,121
Polishing device, J. C. Morrison	139,178
Printing ink attachment, E. A. Howitt	139,155
Printing press, G. A. Hunt	139,156
Propellers, operating screw, J. Wilcoxen	139,098
Pruning shears, J. S. Crum	139,119
Pump, compound steam, A. J. L. Loretz	139,070
Pump, compound steam, A. J. L. Loretz	139,071
Pump, submerged force, A. T. Halford	139,003
Pump, steam, W. Aldrich	139,103
Punch and nippers, hand, J. O. Reilley	139,079
Range, cooking, J. L. Pfau, Jr	139,187
Railroad switch, C. H. White	139,220
Railroad switch signal, J. Cullen	139,146
Railroad tie, W. H. Sterling	139,031
Railroad water column, J. N. Poage	139,188
Railway links, forming, P. H. Healey	139,005
Railway scale platform, C. C. Warren	139,216
Razor strop, J. B. Lucas	139,011
Reamer, adjustable, A. Shedlock	139,057
Refrigerator, W. H. Lewis	139,168
Refrigerator and sideboard, G. L. Packard	139,186
Refrigerator, etc., J. F. Schneider	139,197
Rolling metal, George & Durfee	139,000
Roofing slates, attaching, S. Farquhar	138,999
Safe, milk, J. P. Dale	139,120
Saw blanks, case for, C. I. Walker	139,094
Saw filing machine, C. F. Henis	139,149
Saw setting machine, W. H. Dobson	139,124
Saw sharpening machine, F. E. Frey	139,139
Scraper, road, L. P. Wright	139,099
Screw and clamp jack, Jackson & Watson	139,157
Screw driver, C. Law	139,069
Seat, folding, W. W. Parker	139,021
Seed dropper, E. L. Gross	139,143
Sewing machine, E. W. Beebe	139,010
Sewing machine, J. A. Davis	138,996
Sewing machine, L. W. Lathrop	139,067
Sewing machine hemmer, E. Howell (r)	5,414
Sewing machine ruffler, etc., A. Johnston	139,064
Sewing machine ruffler, etc., F. Sievers	139,089
Shaft, vehicle, Connor & Pfisterer	139,117
Shafting, manufacture of, Kneisly & Wensthoff	139,165
Shingle machine, S. M. King	139,162
Shoe fastening, M. Boch	139,109
Spark arrester, E. Fontaine	139,053
Spark arrester, J. W. Gray	139,002
Spikes, extracting, Barsalouse & Graham	138,988
Spinning stop, electrical, H. A. Chapin	138,993
Spinning mule, J. J. Dewey	139,051
Spittoon, H. Toungue	139,218
Spring, door, M. L. Webster	139,037
Station indicator, C. Barton	138,989
Steam condenser, J. L. Alberger	139,102
Stirrup, safety, L. R. Jones	139,160
Stone, artificial, W. H. Lewis	139,167
Stove, coal oil, J. H. Thorp (r)	5,418
Stove, heating and cook, R. McConnell	139,172
Stove, heating, C. G. Thompson	139,035
Stove pipe damper, J. Emmert	138,997
Stove pipe thimble, F. Tarrant	139,210
Stove polish, J. I. Danforth	139,047
Sugar, manufacture of, A. F. W. Partz	139,078
Telegraph, printing, T. A. Edison	139,128
Telegraph, printing, T. A. Edison	139,129
Thill coupling, J. H. Parkhurst	139,022
Thrashing machine, H. Wehler	139,218
Thrashing machine attachment, W. Masterton	139,073
Time printing machine, J. C. Hinchman	139,153
Time printing machine, J. C. Hinchman	139,154
Tongs, guttering, J. Schwartz	139,198
Trap, animal, G. A. Norman	139,182
Trunk, G. B. Jenkinson	139,158
Umbrella stretchers, J. Shepard	139,088
Valve, automatic regulating, G. L. Kitson	139,168
Valve, balanced, F. P. Cady	138,992
Valve for cut-off, rotary, J. W. Strange	139,033
Valve, safety, G. Swenson	139,209
Vehicle wheel, J. Hageman	139,144
Vessels, center and bilge keels for, S. P. Willeby	139,222
Wagon brake shoe, H. Seitz	139,086
Wagon seat, J. U. Shultz	139,027
Washing machine, L. Beaulieu	139,107
Washing machine, A. Filkins	139,135
Washing machine, A. W. Jennings	139,159
Washing machine, J. Rigsbee	139,191
Washing machine, G. W. Wageoner	139,093
Washing machine, W. S. Young	139,100
Waterproofing canvas, etc., P. H. Morgan	139,017
Water wheel, Abell & Cole	138,979
Water wheel chute, J. Abell	138,978
Well, driven or bored, J. E. Morrison	139,018
Whip handle cap, G. A. Burr	138,991
Whip socket, A. Searles	139,026
Windmill, T. R. & A. C. Jackson	139,007
Wind wheel, A. Raymond	139,189
Window screen, W. H. Fletcher	139,128
Wrench, pipe, G. P. Moloney	139,177

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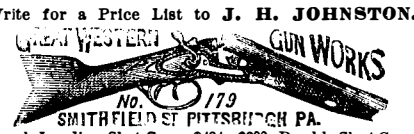

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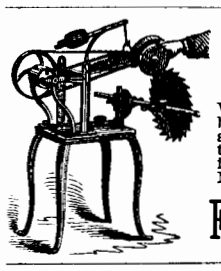

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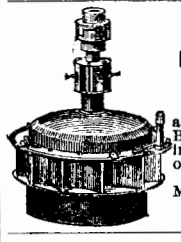

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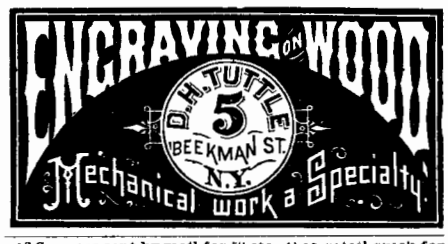

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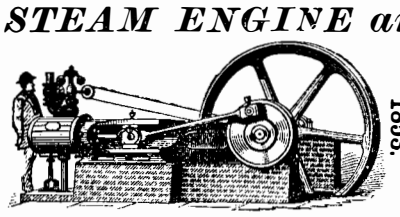

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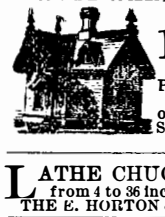

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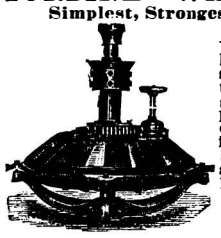

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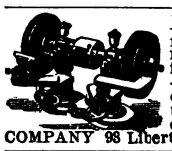

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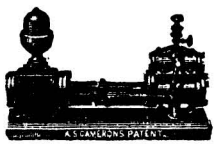

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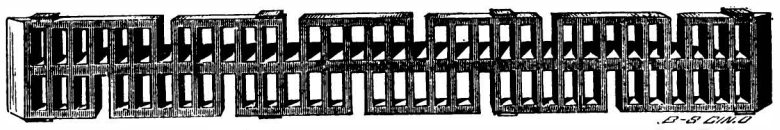

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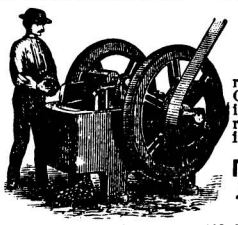

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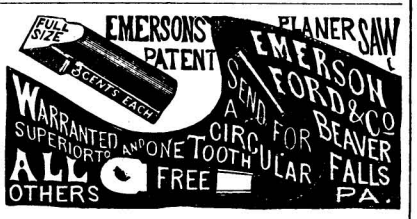

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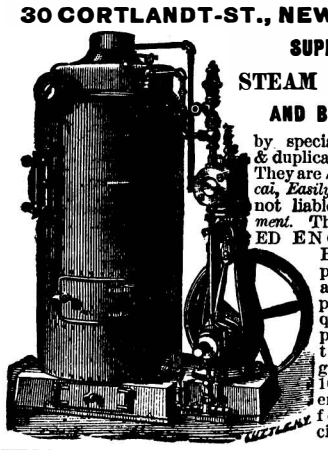

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